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JOHN MUIR'S IMAGE OF THE WEST[1]

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IT has fallen to my lot to deliver this address at the first meeting held by our Association on the west coast. Many of you are using the opportunity offered by your attendance here to add to your personal knowledge of this part of the continent. It seemed to me appropriate, therefore, to use the occasion of my speaking to you for the purpose of calling, and recalling, to your attention a great figure of the past who devoted himself to the interpretation of the West. His literary executor, William Frederic Badè, wrote, in introducing his collected works: "Thousands and thousands, hereafter, who go to the mountains, streams, and cañons of California will choose to see them through the eyes of John Muir, and they will see more deeply because they see with his eyes."[2]

It is not solely nor principally for the sake of the factual information that John Muir's writings provide in abundance that I wish to commend them to your attention. I wish in addition to nominate him to a place in our list of secular saints, to a place among those whom we cite familiarly and to whose works we refer our students for enlightenment and stimulation. We can all profit from giving attention to his attitude toward the land, and especially to his habits of observation.

MUIR AND THE WEST

Muir's memory is most closely associated with the Sierra Nevada, particularly with the region included in Yosemite National Park. But his travels took him into all parts of the West, and his writings span the whole stretch of the Pacific coast of North America from southern California to Bering Strait. Nevada and Utah, and even Arizona, provided material for some of them.[3] He visited the coastal parts of Alaska five times; and his exploration of Glacier Bay on one of these visits must rank only second to his work in the Sierra Nevada. It is immaterial whether he was or was not the first to set foot on any particular spot, of ice or of rock. By far the greater part of what he wrote is concerned with places that were, and are, accessible to any robust and hardened walker and climber. Of perhaps greater importance than what he saw is how he saw and described it.

Muir arrived in California, by way of the Isthmus of Panama, ninety years ago last spring: at the beginning of April, 1868. In more than one place he tells of his first view of California. He took the ferry across the Bay from San Francisco to Oakland, and in the company of a young Englishman walked southward through the Santa Clara Valley to Pacheco Pass, through that pass to the San Joaquin Valley, across the Valley and into the mountains to Yosemite. His freshest and most enthusiastic account of that tour is contained in a letter to Mrs. Ezra Carr, whose motherly interest and encouragement guided his early intellectual and literary growth. "The hills bordering the Santa Clara Valley," he wrote Mrs. Carr in July, 1868, "were robed with the greenest grass and richest light I ever beheld,

[1] Address by the honorary president of the Association of American Geographers at its 54th annual meeting, Santa Monica, California, August 21, 1958.

[2] "Introduction," *The Writings of John Muir*, Vol. 1 (Boston and New York, 1919), pp. xi–xii.

[3] The individual work that contains material on the largest number of western regions by Muir is the sumptuous *Picturesque California: the Rocky Mountains and the Pacific Slope . . .* (New York and San Francisco, 1887). Muir edited this work, and contributed to it the chapters "Peaks and Glaciers of the High Sierra," "The Passes of the High Sierra," "The Yosemite Valley," "Mount Shasta," "Alaska," "Washington and Puget Sound," and "The Basin of the Columbia River."

and colored and shaded with millions of flowers, of every hue, chiefly of purple and golden yellow." But the climax of the journey was his view of the San Joaquin Valley after he had traversed Pacheco Pass:

> This valley of the San Joaquin is the floweriest piece of world I ever walked, one vast level, even flower-bed, a sheet of flowers, a smooth sea ruffled a little by the tree fringing of the river and here and there of smaller cross streams from the mountains. Florida is indeed a land of flowers, but for every flower creature that dwells in its most delightsome places more than a hundred are living here. Here, here is Florida.[4]

Surely no young man ever had a more auspicious introduction to a land he had come from afar to see.

Muir's first long visit in the Sierra was in the summer of 1869; he then commenced the meticulous examination of the mountains, especially of the upper drainage basins of the Merced and Tuolumne rivers, that gave him a knowledge of this region probably equaled only by that gained by François Matthes in the present century.

I have no evidence that Muir intended, when he began his five-year exploration of the Sierra, to write about it for publication. He had already, however, acquired the habit of keeping detailed records of his observations in notebooks, and he wrote fully about them in letters, especially to Mrs. Carr, who prepared some of his letters to her for publication. His strongest impulse to publication was his desire to establish for himself credit for the discovery of existing glaciers in the Sierra, a discovery he made in the autumn of 1871.[5] By the summer of 1872 he was eager to write; and once he began to coin his journals into manuscript for publication he produced an astonishing number of articles in the eighteen-seventies. Most of these were published in *The Overland Monthly* of San Francisco, but a number appeared in *Harper's Monthly Magazine*, and so reached a large audience.[6] In the same years he contributed a large number of accounts of his travels and observations to the San Francisco *Bulletin*.[7] The characteristic sequence in the history of his writings was: full entries in his notebooks, articles in magazines or newspapers, and, long afterward, books, which were collections of the articles published earlier, more or less revised.[8]

It is Muir's writings from these early years in the West that have the greatest value for us of after time, not those from his later years when he had become a propagandist—in however good a cause—and a public figure, almost a public monument. This productive period was brought to a close by his settling down, after his voyage to Bering Sea and its neighboring coasts in 1881, on his father-in-law's fruit ranch near Martinez, when for six years he published nothing.

Many others were writing about the West during the forty-odd years that include Muir's career of authorship. His most conspicuous part in the scientific and literary conquest of the West was the description and celebration, and in part the scientific explanation, of areas that were not yet subjugated to settlement, which in Muir's eyes was nearly synonymous with their defilement. Aside from his discovery of the existing glaciers of the Sierra, his most important scientific contribution is contained in a series of papers published in *The Overland Monthly* in 1874 and 1875 under the general title "Studies in the Sierra."[9]

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[4] *Letters to a Friend. Written to Mrs. Ezra Carr 1866–1879* (Boston and New York, 1915), pp. 39, 40. Muir's writings will be cited here by title only, without repetition of his name. If more than one edition of a book has appeared, the pagination cited is that of the original edition.

[5] *Cf.* "Living Glaciers of California," *Harper's Monthly Magazine*, Vol. 51 (1875), pp. 769–76.

[6] Jennie Elliot Doran, "A Bibliography of John Muir," *Sierra Club Bulletin*, Vol. 10 (1916), pp. 41–54.

[7] Cornelius Beach Bradley, "A Reference List to John Muir's Newspaper Articles," *idem*, pp. 56–9.

[8] These collections (all published at Boston and New York) are: *The Mountains of California* (1894, new and enlarged edition, 1911); *Our National Parks* (1901, new and enlarged edition, 1909); *My First Summer in the Sierra* (1911); *The Yosemite* (1912); *Travels in Alaska* (1915, thus posthumous, but nearly ready for the printer at the time of Muir's death in December, 1914). *The Cruise of the Corwin* (1917) and in part *Steep Trails* (1918) are similar collections edited by William Frederic Badè.

[9] I, "Mountain Sculpture," Vol. 12 (1874), pp. 393–403; II, "Mountain Sculpture—Origin of Yosemite Valleys," *idem*, pp. 489–500; III, "Ancient Glaciers and their Pathways," Vol. 13 (1874), pp. 67–79; IV, "Glacial Denudation," *idem*, pp. 174–84; V, "Post-glacial Denudation," *idem*, pp. 393–402; VI, "Formation of Soils," *idem*, pp. 530–40; VII, "Mountain Building," Vol. 14 (1875), pp. 64–73. These were reprinted in *Sierra Club Bulletin*, Vol. 9 (1915), pp. 225–39; Vol. 10 (1916–19), pp. 62–77, 184–202, 304–18, 414–28; Vol. 11 (1920–21), pp. 69–85, 181–93. More recently the Sierra Club has issued them, with an Introduction by William E. Colby and a Foreword by John P. Buwalda, in the volume *John*

Much of the content of these solid contributions to the geomorphology of glaciated mountains has become a commonplace part of the content of textbooks. This fact, while it reduces their interest when one reads them now, testifies to their permanent value. Their most important content is detailed evidence of the control exercised over the sculpture effected by glaciers, especially over plucking, by the jointing of the rocks. This principle was one that Muir insisted upon: "The most telling thing learned in these mountain excursions is the influence of cleavage joints on the features sculptured from the general mass of the range."[10] The first of his "Studies in the Sierra" reaches a fuller and more forcible conclusion:

> . . . when we say that the glacial ice-sheet and separate glaciers *molded* the mountains, we must remember that their molding power upon *hard granite* possessing a strong physical structure is comparatively slight. In such hard, strongly built granite regions, *glaciers do not so much mold and shape, as disinter forms already conceived and ripe.* The harder the rock, and the better its specialized cleavage planes are developed, the greater will be the degree of controlling power possessed by it over its own forms, as compared with that of the disinterring glacier; and the softer the rock and more generally developed its cleavage planes, the less able will it be to resist ice action and maintain its own forms. In general, *the grain of a rock determines its surface forms* . . .[11]

There is other excellent material in these studies, but also conclusions that are unacceptable, such as Muir's great overestimation of the depth of erosion by glaciers.

Never again did Muir attack a scientific question of any magnitude. He traveled widely and wrote copiously, but he never spent enough time in any other region than the Sierra Nevada to discover or solve a significant problem. "Patient observation and constant brooding above the rocks," he wrote to Mrs. Carr, "lying upon them for years as the ice did, is the way to arrive at the truths which are graven so lavishly upon them."[12] He had no opportunity to brood thus over any other region. In fact, his prolonged and intense attention to the Sierra was an obstacle to his understanding of landscapes having different histories. The Sierra became for him the model and norm for all mountains, so that wherever he went—among the basin ranges of Nevada, the Cascade Mountains of Oregon and Washington, or the coastal mountains of Alaska and northeastern Siberia—he saw glacially smoothed uplands, Yosemites more or less complete, and summit sculpture by cirque glaciers. "Go where we will," he wrote in Alaska, "all the world over, we seem to have been there before."[13] The mental image he had formed of the past and present forms of the Sierra was so complete and detailed that all the mountain forms he saw could be fitted into it. He clambered about Mount Shasta and explored other parts of the volcanic northeastern part of California; but the land forms produced by vulcanism did not arouse his wonder. He missed completely the nature of the relief of the Great Basin, seeing in the basin ranges drumlinoid forms that to him were evidence of a general glaciation. On the west coast of Alaska he recorded some observations of ground ice exposed in a wave-cut cliff that would have been new and interesting if adequately discussed and interpreted. We may excuse Muir for not investigating these exposures closely, for he was ashore at the site only a few hours. But within this short time he found an all too easy explanation of the largest mass of ground-ice he encountered: he diagnosed it as the last remnant of a glacier preserved against a north-facing slope, identifying it with the remnant cirque glaciers he knew in the Sierra. His eyes were still keen to see and his pen diligent to record; but he scarcely acquired a single new insight after his first few fruitful years in the Sierra Nevada.

It can scarcely be doubted that Muir had enough scientific competence to enable him to contribute more to the natural history of the West than he did. But even in his productive years in the seventies he published many more descriptive articles addressed to the general reader than solid additions to scientific knowledge. One reason for his doing so was certainly economic; writing about the country he loved was a more congenial way

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Muir's Studies in the Sierra (San Francisco, 1950). Muir published a summary of them under the title "Studies in the Formation of Mountains in the Sierra Nevada" in the *Proceedings*, American Association for the Advancement of Science, Vol. 23 (1875), pp. 49–64.

[10] *My First Summer in the Sierra*, p. 341.

[11] "Studies in the Sierra. No. I—Mountain Sculpture," *Overland Monthly*, Vol. 12 (1874), pp. 393–403. Passage cited from p. 403.

[12] *Letters to a Friend*, p. 157.

[13] *Travels in Alaska*, p. 77.

of supporting himself than the work he did in his first years in California. But later, when his economic position was secure, he made no effort to reach any other than a general audience.

I do not wish to make an invidious distinction between Muir's "Studies in the Sierra" and his other writings. The contrast between avowedly scientific and so-called "popular" writing has been vastly sharpened in the past eighty years, with the decline of the literate monthly magazines. Muir's articles intended for the general public are as carefully written and contain as detailed and accurate observation as any scientific writing. They differ in that the evidence carefully marshaled is not focused on an objective intellectual problem, but rather on the reader. In them Muir is attempting to share with the reader his emotional reactions to his observations. The data of observation themselves might as well have been used for a more strictly scientific purpose.

The characteristic form of any one of these essays was evidently given by a coherent block of material in one of Muir's notebooks. Its nucleus might be a scene or an incident. About the framework of factual report Muir wrapped a covering of interpretation drawn from his emotional experiences in the presence of the phenomena observed, and these experiences were what he was most eager to report to his readers.

It was not merely shallow sentiment that Muir invited his readers to share. He was convinced that the emotional rewards of association with nature increase with intellectual understanding, and his writings confirm that conviction: his own efforts are least successful when he is writing about things he did not understand, such as certain meteorologic phenomena and the movements of water. The reader of Muir's works must inevitably take a position with reference to the emotion that informs them. Some may reject these writings out of hand because Muir's subjective attitude toward nature is distasteful, and some may reject his interpretations and reflections while appreciating the factual material he recorded. But there is much to be gained from a sympathetic examination of the point of view from which he looked upon the world. I would suggest that in the study of nature the pursuit of ends other than those called "scientific," if done in spirit and in truth, is intellectually just as praiseworthy and rewarding as the search for strictly rational connections.

THE RECEPTIVE MIND

As is true of all of us, what Muir saw and reported depended at least as much on the mind that received and assimilated his observations as on the objects observed; and his interpretative reflections provide insights into the mind on which these observations impinged. Henry Fairfield Osborn, who had enough personal association with Muir to justify his speaking with some authority, wrote of him: "I have never known anyone whose nature-philosophy was more thoroughly theistic at the same time as he was a thoroughgoing evolutionist."[14] Osborn, using terms made familiar by the great controversy of the latter part of the nineteenth century, appears to suggest that these two aspects of Muir's view of nature were in conflict. I find no conflict whatever in his writings. His "theism" was very close to pantheism. The God whose name he frequently uses is not one that would find a place in any dogmatic theology. This God, who in Muir's writings presides over the universe, is often replaced, in a neighboring paragraph or sentence, by a more or less personified, maternally solicitous Nature. In other passages these personifications are attenuated to an "eternal, invincible Harmony" among natural processes and their material products. In most instances the presiding entity is scarcely distinguishable from what is often called by the more colorless term "ecologic balance." The attribution of personality to the principle of continuity and balance in nature gives a warmth to Muir's descriptions and interpretations that his emotional constitution evidently demanded. He saw the matrix of natural events as divine love, extended particularly toward living things. "God's love covers His world like a garment of light," he wrote in his journal.[15] This love is foresighted, teleologic: the glaciation of the Sierra Nevada, for example, was a device by which suitable habitats were prepared for the great variety

[14] *Impressions of Great Naturalists* (New York, 1924), p. 199.

[15] Linnie Marsh Wolfe, ed., *John of the Mountains: the Unpublished Journals of John Muir* (Boston, 1938), p. 81.

of plants that range upward from the valleys through the belt of forests to the raw moraines in the glacial cirques; and for the animals that accompanied the plants on their march upward as the glaciers receded. Osborn should not have been astonished that in Muir's eyes such a farsighted and solicitous love could use evolution as easily as glaciation to achieve its ends.

Muir parted company with most contemporary evolutionists in his insistence on the quality of benevolence in the processes of nature. He rejected Darwin's word "struggle" (forgetting Darwin's own qualification of the term in *The Origin of Species*) as "ungodly."[16] I have found in his writings only one account of a creature he could not fit into the scheme of harmony he saw in nature. This is his description of certain small, savage black ants whose acquaintance he made during his first summer in the Sierra. Of these "fearless, restless, wandering imps" he writes that:

> ... they fight anywhere and always wherever they can find anything to bite. As soon as a vulnerable spot is discovered on man or beast, they stand on their heads and sink their jaws, and though torn limb from limb, they will yet hold on and die biting deeper. When I contemplate this fierce creature so widely distributed and strongly intrenched, I see that much remains to be done ere the world is brought under the rule of universal peace and love.[17]

This questioning of the universal rule of divine love is, however, highly exceptional if not unique.

Muir used this pervasive love as the basic organizing concept of his interpretation of the natural world. Few of the naturalists of his generation appealed to it, though many of them recognized a moral obligation toward nature. In the fundamental set of his mind Muir was to a substantial degree an anachronism, carrying into the Brown Decades attitudes that belonged to the Golden Day or even earlier times. He owed much to Emerson and Thoreau, and something to the romantics of the first half of the nineteenth century.

He had received good instruction in the sciences at the University of Wisconsin, and had pursued the study of nature independently for several years before coming to California. He had set his aim high. "How intensely I desire to be a Humboldt!" he had written to Mrs. Carr in September, 1866.[18] It was this ambition that led him to California, even though as a second choice after his intention to follow Humboldt's footsteps into South America was thwarted. He had the bodily strength and agility required for the exertions he undertook, and habits that made him nearly independent of other human beings. He simplified the techniques of travel in the mountains so as to reduce the amount of gear he carried with him to a minimum that most persons would consider inadequate. On the one occasion when he took a pack animal with him when traveling alone—his excursion, undertaken in the autumn of 1875, to determine how far southward the sequoia extended in the Sierra — he found the mule Brownie, whose services had been urged upon him, more of a hindrance than a help. As Emerson said of Thoreau, "he chose to be rich by making his wants few and supplying them himself." By inuring himself to prolonged travel on foot with a light pack, he freed himself to observe and record. "You are all eyes, sifted through and through with light and beauty."

THE OBSERVING EYE

Muir's works abound in evidence of a consummate power of observation. Rocks, clouds, trees, flowers, animals, the great and the small, attracted his attention and found their way into his notebooks. In a letter to Mrs. Carr he described his "method of study" of the evidences of glaciation in the Sierra:

> I drifted about from rock to rock, from stream to stream, from grove to grove. Where night found me, there I camped. When I discovered a new plant, I sat down beside it for a minute or a day, to make its acquaintance and try to hear what it had to say. When I came to moraines, or ice-scratches upon the rocks, I traced them, learning what I could of the glacier that made them. I asked the boulders I met whence they came and whither they were going. I followed to their fountains the various soils upon which the forests and meadows are planted; and when I discovered a mountain or rock of marked form and structure, I climbed about it, comparing it with its neighbors, marking its relations to the forces that have acted upon it, glaciers, streams, avalanches, etc., in seeking to account for its form, finish, position, and general characters. It is astonishing how high and far we can climb in mountains that we love, and how little we require food and clothing.[19]

The latter-day reader is likely to linger most appreciatively over those passages in which

[16] *Idem*, p. 118.
[17] *My First Summer in the Sierra*, pp. 57, 58–59.
[18] *Letters to a Friend*, p. 9.
[19] *John of the Mountains*, p. 69.

Muir describes things that are not ordinarily noticed. His accounts of some of his feats of observation, such as his view of the behavior of a Sierra forest in a windstorm from the swaying top of a tree,[20] have been reproduced often enough to become widely familiar. I shall call your attention to some less spectacular examples. There are, for example, his remarks on the beads of dew seen on spider webs in the morning, which, he asserts, "are of all the forms of water the most delicate and beautiful I have ever seen."[21] There are his notes on the spray above the surface of a cascading stream, formed by the bursting of bubbles of air caught in the water. "These drops rise in curves, often meeting at the top just before they begin to descend, and forming a series of interlacing arches."[22] Observing a cloud of insects in Alaska, moving "in giddy whirls and spirals," he noted that they circled "mostly from left to right, with the sun, into which they are geared in some mysterious way."[23] While he was exploring the southern parts of the sequoia belt, he encountered a forest fire. He tethered Brownie, the mule, at a safe distance, and watched at close range the behavior of the fire.[24] In the midst of a howling storm on the peak of Mount Shasta, when it was uncertain whether he and his companion would be able to get down safely, he noticed that every hailstone, "as far as I could see, was regular in its form, six-sided pyramids with rounded base . . ."[25]

One of his records of unusual observation that I like best is his description of the flow of water down the trunks of trees during a heavy winter rainstorm in the Sierra:

> Every tree possessed a water system of its own: streams of every species were pouring down the grooves of each trunk, organized as regularly as Amazons and Mississippis; their tributaries widely branched and distributed over the valleys and tablelands of the bark; their currents in floodtime choked with moss-pedicels and muddy with spores and pollen, spreading over shallows, deepening in gorges, dividing, conflowing, and leaping from ledge to ledge. When patiently explored, these tree-rivers are found to possess much the same scenery as the rivers of the ground. Their valleys abound in fine miniature landscapes, moss bogs enliven their banks like meadows, and thickets of fruited hyphae rise here and there like forests. And though nearly vertical, these minute tree-rivers are not all fall. They flow in most places with smooth currents that mirror the banks and break into a bloom of foam only in a few special places.[26]

The reader also finds, especially in the introductory paragraphs of articles, descriptions of general views from high points. These inclusive views are the ones most likely to stimulate Muir to reflection, and the more inclusive the view the more general the reflection. Having climbed to the peak of Mount Ritter, and looking over an expanse that stretched westward and eastward from the Coast Ranges far into the Great Basin, he wrote:

> Here are the roots of all the life of the valleys, and here more simply than elsewhere is the eternal flux of nature manifested. Ice changing to water, lakes to meadows, and mountains to plains. And while we thus contemplate Nature's method of landscape creation, and, reading the records she has carved on the rocks, reconstruct, however imperfectly, the landscapes of the past, we also learn that as these we now behold have succeeded those of the pre-glacial age, so they in turn are withering and vanishing to be succeeded by others yet unborn.[27]

This parallel sweep of the eye through space and of the imagination through time is characteristic. In his journal Muir complained, "Alas, how little of the world is subject to human senses!"[28] He exacted the utmost of his senses; and labored to supplement their incomplete testimony by the exercise of his imagination.

Perhaps the most significant observation that Muir made was the one that led to his first discovery of an existing glacier in the Sierra, which was, moreover, the first glacier he had ever seen. The following account of this discovery is the first one he published; it is more spontaneous than the later, soberer one included in *The Mountains of California*:

> On one of the yellow days of October, 1871, when I was among the mountains of the "Merced group" following the footprints of the ancient glaciers . . . , reading what I could of their history, . . . I came upon a small stream that was carrying mud of a kind I had never seen. In a calm place, where the stream widened, I collected some of this mud, and observed that it was entirely mineral in

[20] "A Windstorm in the Forests of the Yuba," *Scribner's Monthly*, Vol. 17 (1878), pp. 55–9; *The Mountains of California*, pp. 251–56.

[21] *John of the Mountains*, pp. 103–4.

[22] *Idem*, p. 208.

[23] *Idem*, p. 339.

[24] *Our National Parks*, pp. 307–13.

[25] *Picturesque California* . . . , p. 162.

[26] "Flood-storm in the Sierra," *The Overland Monthly*, Vol. 14 (1875), pp. 489–96. Passage cited from p. 491.

[27] *The Mountains of California*, p. 70.

[28] *John of the Mountains*, p. 44.

composition, and fine as flour, like the mud from a fine-grit grindstone. Before I had time to reason, I said, "Glacier mud—mountain meal."

Then I observed that this muddy stream issued from a bank of fresh quarried stones and dirt, that was sixty or seventy feet in height. This I at once took to be a moraine. In climbing to the top of it, I was struck with the steepness of its slope, and with its raw, unsettled, plantless, new-born appearance. . . .

When I had scrambled to the top of the moraine, I saw what seemed to be a huge snow-bank, four or five hundred yards in length, by half a mile in width. Imbedded in its stained and furrowed surface were stones and dirt like that of which the moraine was built. Dirt-stained lines curved across the snow-bank from side to side, and when I observed that these curved lines coincided with the curved moraine, and that the stones and dirt were most abundant near the bottom of the bank, I shouted "A living glacier!"[29]

Though often expressed in exuberant words, Muir's descriptions are full of precise numerical determinations: "arithmetic for clothing my thoughts," as he wrote to Mrs. Carr.[30] In the letter in which he described the glory displayed by the San Joaquin Valley when he first saw it, he proved how flowery it was by counting and reporting to Mrs. Carr the number of orders, species, and individual plants, and finally the number of flowers, he found on one square yard of ground.[31] While he was looking after sheep in the foothills of the Sierra in the winter of 1868–69, he recorded in his journal an estimate, based on the exposure of the roots of plants, of the rate at which the surface of the hills was being lowered by erosion.[32] Though he traveled light, he seems always to have had with him a tape measure, an aneroid barometer for measuring elevation, and frequently a thermometer. In his study of trees, which he pursued through all his travels, he regularly measured their diameter and height, and counted annual rings on stumps and logs. As soon as possible after his discovery of living glaciers in the Sierra, he planted a row of stakes across one of them in order to measure the rate of its motion.[33]

He exposed himself freely, even foolhardily, to extreme discomfort and danger in order to observe. He climbed down into the bergschrund of the first glacier he found in the Sierra, and into the marginal crevasse of the first fiord glacier he had a chance to examine in Alaska, where he saw "not only its grinding, polishing action, but how it breaks off angular boulder-masses."[34]

NATURE AND MAN

Muir wrote in his journal of two ways in which living creatures may be observed:

> The man of science, the naturalist, too often loses sight of the essential oneness of all living beings in seeking to classify them into kingdoms, orders, families, genera, species, . . . while the eye of the Poet, the Seer, never closes on the kinship of all God's creatures, and his heart ever beats in sympathy with great and small alike as "earthborn companions and fellow mortals" equally dependent on Heaven's eternal love.[35]

Yet his sense of kinship with all of earth's creatures did not extend to many of his fellow humans. The satisfaction he derived from his solitary communion with nature was paired with an aversion toward most of mankind. At times he expressed his disgust and abhorrence in words worthy of Swift. The inhabitants of towns seemed to him particularly degraded: "All are more or less sick; there is not a perfectly sane man in San Francisco."[36] And elsewhere he speaks of "the deathlike apathy of many town-dwellers, in whom natural curiosity has been quenched in toil and care and poor shallow comfort," contrasting them with a group of Alaskan Indians about a campfire on the shore of Glacier Bay.[37]

But he did not romanticize the American aborigines. The human beings he describes in the most Swiftian terms are the Mono Indians he encountered on his first trip through Bloody Canyon in the summer of 1869, and whom he dismissed by saying that "somehow they seemed to have no right place in the landscape, and I was glad to see them fading out of sight down the Pass."[38] He viewed the Indian and Eskimo he met with the same critical reserve with which he regarded everyone else, and wrote of them with the same praise, scorn, pity, or indifference, as occasion

[29] "Living Glaciers of California," *The Overland Monthly*, Vol. 9 (1872), pp. 547–49. Passage cited from p. 547.
[30] *Letters to a Friend*, p. 117.
[31] *Idem*, pp. 41–2. Muir published this enumeration, together with other details of his first trip in the West, in "Rambles of a Botanist among the Plants and Climates of California," *Old and New*, Vol. 5 (1872), pp. 767–72.
[32] *John of the Mountains*, p. 26.
[33] "Living Glaciers of California," *op. cit.*, p. 548.
[34] *Travels in Alaska*, pp. 138–39.
[35] *John of the Mountains*, p. 434.
[36] *Idem*, p. 191.
[37] *Travels in Alaska*, p. 191.
[38] *The Mountains of California*, p. 93.

demanded. His attitude toward human beings was strongly colored by a fastidiousness that was outraged by slovenliness and dirt. He repeatedly contrasts the cleanness of wild animals with the dirtiness of men. "Strange that mankind alone is dirty."[39] "Man seems to be the only animal whose food soils him."[40] "Pollution, defilement, squalor are words that never would have been created had man lived conformably to Nature."[41]

What life conformable to nature might be we can only guess. But certainly one important element in the proper relation of man to the rest of life on earth that Muir envisaged is the recognition that all creatures have an equal right to life and enjoyment, a recognition granted by few human beings. Contemplating the fossil record of life on earth, Muir found it "a great comfort to learn that vast multitudes of creatures, great and small, and infinite in number, lived and had a good time in God's love before man was created."[42] And again: ". . . if a war of races should occur between the world's beasts and Lord Man, I would be tempted to sympathize with the beasts."[43]

In his early days in California Muir was able to avoid town life for the most part, and did not have much occasion to record the discomfort he experienced when visiting Oakland or San Francisco, "diving into that slimy town sea-bottom," as he said in a letter to Mrs. Carr. But even in the Sierra he could not escape the destruction wrought by the predatory inhabitants of the lowlands. The earliest example of such destruction that he had occasion to see was the damage inflicted by sheep driven up into the mountains for summer pasture. Fortunately he was soon able to escape from the hateful occupation of caring for these animals, to which necessity had driven him in his first year in California. But he never ceased to bewail the depredations of these "hoofed locusts," as he always called sheep; and a good part of the motivation of his later work for the preservation of the forests of the West was his knowledge of the damage done to the mountain vegetation by them. Yet he did not vent his loathing primarily on the "poor, helpless, hungry sheep"; he saw them as "in great part misbegotten, without good right to be, semi-manufactured, made less by God than by man, born out of time and place."[44] When he became acquainted with the wild mountain sheep, he compared them drastically and invidiously with the domestic breeds: "These are clean and elegant, the others dirty and awkward. These are guarded by the great Shepherd of us all, those by erring money-seekers."[45]

A second kind of depredation that Muir learned to know early in his sojourn in the Sierra was wasteful lumbering, with its accompanying destructive fires. The forests of the Sierra—the finest in the world, as he often said—were particularly dear to him, and it was primarily in their behalf that he engaged in strenuous propaganda in the latter part of his career. But though he condemned "the invading hordes of destroyers called settlers," though he lamented the destruction, in his own lifetime, of the blanket of golden and purple flowers with which the San Joaquin Valley had greeted him when he first saw it, he could imagine, at least late in his career, a use of the land that would accord with his principles:

> The United States Government [he wrote in 1897] has always been proud of the welcome it has extended to good men of every nation, seeking freedom and homes and bread. Let them be welcomed still as nature welcomes them, to the woods as well as to the prairies and plains. . . . Let them be as free to pick gold and gems from the hills, to cut and hew, dig and plant, for homes and bread, as the birds are to pick berries from the wild bushes, and moss and leaves for nests. The ground will be glad to feed them and the pines will come down from the mountains for their home as willingly as the cedars came from Lebanon for Solomon's temple. Nor will the woods be the worse for this use, or their benign influence be diminished any more than the sun is diminished by shining. Mere destroyers, however, tree-killers, wool and mutton men, spreading death and destruction in the finest groves and gardens ever planted—let the Government of the United States hasten to cast them out and make an end of them.[46]

The great moral imperative that recurs in Muir's writings is that man respect the rest of the natural world. It excludes absolutely the

[39] *My First Summer in the Sierra*, p. 78.
[40] *Idem*, pp. 104–5.
[41] *John of the Mountains*, p. 222.
[42] *The Story of My Boyhood and Youth* (Boston and New York, 1913), p. 84.
[43] *A Thousand-mile Walk to the Gulf* (Boston and New York, 1916), p. 122.
[44] *My First Summer in the Sierra*, pp. 128–29.
[45] *John of the Mountains*, p. 178.
[46] "The American Forests," *The Atlantic Monthly*, Vol. 80 (1897), pp. 145–57. Passage cited from p. 156.

"enormous conceit" "that the world was made especially for the uses of man." Against this pernicious doctrine he inveighs again and again. There is a certain irony in the linking of Muir's name with the movement loosely called "conservation," for the doctrine of subordination of nature to man has been central in our official conservational policies. In Muir's last and unsuccessful struggle to preserve nature from depredation, to prevent the use of Hetch Hetchy Valley, supposedly safe within the bounds of Yosemite National Park, from use as a water reservoir for the city of San Francisco, the decisive influence that moved Congress to permit the Park to be thus despoiled was apparently exerted by that paladin of "conservation," Gifford Pinchot.[47]

Of the naturalist proper Muir demanded more than passive recognition of the rights of all living things to access to the sources of life on the earth. The naturalist must also be animated by a positive love of nature. This is the quality he admired most in the naturalists he had occasion to praise: in Linnaeus, for example, whose great influence he ascribes to Linnaeus' love of nature and natural things.[48] He attributes the same love to Charles Sprague Sargent, author of the great *Silva of North America*.[49] To his regret, he found less of it in Asa Gray, when he made Gray's personal acquaintance, than he had expected to find.[50]

A SIERRA OF THE SPIRIT

Muir's intense devotion to nature gives a pathos to his writings that is denied to more restrained observers. At times he expresses it with so much warmth that we are embarrassed when reading his words as, according to report, his more reticent associates were sometimes embarrassed by his conversation. On rare occasions the vehemence of his words carries him beyond the bounds of good taste. Yet if I apply to his writings the test for false sentiment suggested by P. G. Hamerton, that if the character of a landscape evokes emotions "it is only a part of veracity to describe these effects on the mind,"[51] I find no evidence that he exaggerated his sentiments. At least he confided to his journal and to private letters expressions as warm as any he wrote for publication, expressions that in most of us would seem gross exaggerations of our actual feelings. His capacity for sympathy with nature was obviously far greater than most of us possess, as was his capacity for close and concentrated observation and for hard physical exertion and endurance of prolonged and intense discomfort. Without these traits he would not have been able to perform the work he did. They are good traits, whose excess is less to be deplored than their deficiency.

Muir's attitude toward nature was singularly balanced, combining inseparably and harmoniously intellectual, esthetic, and ethical constituents. The immediate profit of his observations was esthetic; his writings are as much a hymn to beauty as to divine love. "Beauty is universal and immortal, above, beneath, on land and sea, mountain and plain, in heat and cold, light and darkness."[52] Intellectual inquiry adds intensity to the perception of beauty, and the recognition of beauty sharpens the senses and quickens intellectual curiosity. Finally, the recognition of order and coherence in nature—"When we try to pick out anything by itself, we find it hitched to everything else in the universe"[53]—provides a guide to action through a sense of the common origin we share with the rest of nature, and of our responsibility toward it.

The ultimate appeal that Muir makes in his descriptions of the West is "Come to the mountains and see." This is a generous and noble invitation. I invite you to contemplate Muir's serene and harmonious view of nature, a veritable "higher Sierra" of the human spirit. We may not be able to climb to this exalted height, as few of us would be able to follow Muir to the peaks of the physical mountains of the West; but our own less aspiring minds can not avoid receiving some ennobling influence from it. "Doubly happy," wrote Muir,

[47] Hans Huth, *Nature and the American* (Berkeley and Los Angeles, 1957), p. 183.

[48] "Linnaeus," *in* Charles Dudley Warner, ed., *Library of the World's Best Literature*, Vol. 16 (New York, 1897), pp. 9077–83. Reference to p. 9081. I fear that Muir ascribed to Linnaeus too much of his own emotional warmth. I fear, too, that Linnaeus harbored the (to Muir) ultimate heresy that the world was created for the use of man.

[49] "Sargent's Silva," *The Atlantic Monthly*, Vol. 92 (1903), pp. 9–22. Reference to p. 10.

[50] *Letters to a Friend*, p. 128.

[51] Philip Gilbert Hamerton, *Landscape* (Boston, 1885), p. 64.

[52] *The Mountains of California*, p. 337.

[53] *My First Summer in the Sierra*, p. 211.

"is the man to whom lofty mountain-tops are within reach, for the lights that shine from there illumine all that lies below."[54]

The kind of observation and reporting of nature that Muir practiced has, fortunately, not been lost. One of its capable practitioners of the present generation, Loren Eiseley, has recently called attention to some modern instances of it and has attempted to place it in the history of science.[55] He contrasts this "literary, personal and contemplative" kind of writing about nature with its opposite, "severely experimental, unaesthetic and empirical," which he calls "Baconian." That label is a good one, for it recalls the brazen clang of Bacon's injunction to seek knowledge for the sake of controlling nature. "It is not necessary to take sides in this perennial controversy," Eiseley hastens to assure us. "The good men, like Charles Darwin, have always known the best that could be derived from either point of view." It is, I believe, more profitable to think, not of a sharp antithesis, but rather of a gradation, a spectrum, that stretches between the extremes that Eiseley defines. At a time such as the present, when the Baconian end of the spectrum is glowing with particular brilliance, it is good for this group to remind itself that its natural affinities lie toward the opposite end, toward the pole where stand such figures as Gilbert White of Selborne and W. H. Hudson. It is a good company we meet when we turn in that direction, and not the least member of it is John Muir. We can still learn from him: not only about the West, but also about the world in general and the joy and wisdom that come from the contemplation of it.

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[54] *Steep Trails*, p. 211.

[55] "The Enchanted Glass," *The American Scholar*, Vol. 26 (1957), pp. 478–92. Reference to p. 478.

THE PORT OF GENOVA: EXTERNAL AND INTERNAL RELATIONS[1]

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GENOVA is Italy's leading port rivaling Marseilles as the most important port in the Mediterranean.[2] It has achieved its present status basically because of its location with respect to the rich agricultural and industrial centers of the Po Valley with which it is connected by the low Giovi pass through the Ligurian Appennines (Fig. 1). Through this gateway low-value, bulk industrial and agricultural raw materials, plus power minerals like coal and oil, are funneled to the interior, and to a lesser degree high-value industrial end products are exported overseas.

This paper is concerned with an analysis and interpretation of some of the existing relationships between the port of Genova, its overseas "foreland,"[3] and its internal hinterland. It is felt that a study of these spatial interchanges can provide important keys to an understanding of the present structure and possible future development of this port.[4]

THE OVER-ALL TRAFFIC PATTERN

As noted above, Genova is the most important Italian port, accounting for roughly one fifth of the nation's maritime traffic. Its share has, however, declined steadily since 1938 as a result of intensified competition, particularly with the smaller Italian ports which are now equipped for the handling of bulk commodities, like petroleum, coal, and iron ore. Nevertheless, the over-all growth of Genova's traffic has been striking, for in 1956 freight movements totalled over fourteen million tons, almost double prewar levels. (All tonnage data in this report are metric tons.) Table 1 and Figure 3 indicate the historical trends in imports and exports. It is evident from the export and import data that the pattern is heavily imbalanced, for imports in recent years have been six times the export tonnages.[5] This phenomenon has always been a problem in the port's operations, but it has been intensified in the postwar period. It has

TABLE 1.—FREIGHT TRAFFIC THROUGH THE PORT OF GENOVA

	1938[1]		1956[2]	
	Tons[3]	Percent	Tons	Percent
Imports	5,674,664	78.0	12,038,642	85.6
Exports	1,599,308	22.0	2,022,292	14.4
Total	7,273,972	100.0	14,060,934	100.0

[1] Source: *Relazione Statistica, 1955*, C.A.P. (Consorzio Autonomo del Porto di Genova) (Genova, 1956), p. 25.
[2] Source: *Traffic in the Port of Genova during 1956*, C.A.P. (Genova, 1957), p. 11.
[3] All tonnage data cited in this study are in metric tons.

[1] This paper is one of several studies resulting from field work in Italy undertaken with the sponsorship of The Mineral Industries College of The Pennsylvania State University and the Office of Naval Research. Reproduction in whole or in part is permitted for any purpose of the United States Government. The maps for this paper were drawn by Mr. Neil Walp and Mr. Jack Pensyl, graduate students in the Department of Geography at The Pennsylvania State University.

[2] The classic study of the port of Genova was that by Geoffredo Jaja, *Il Porto di Genova*, Consiglio Nazionale delle Ricerche, Comitato Nazionale per la Geografia, Vol. VI (Rome, 1936). Other major substantive studies of this port which have been consulted in the course of this study include Maurice Byé, *Le Port de Gênes* (Paris, 1928); J. A. Perrét, *Le Port de Gênes* (Paris, 1937); H. Goehrtz, *Die Hafen Italiens, Veröffentlichungen des Geographischen Instituts der Albertus Universität zu Koenigsberg*, No. 10 (1937).

[3] The term "foreland" is adopted from Guido Weigend, "The Problem of Hinterland and Foreland as Illustrated by the Port of Hamburg," *Economic Geography*, Vol. 32 (1956), p. 3. Weigend defines foreland as "those areas which are connected with that port by means of ocean carriers."

[4] It should be stressed at the outset that many facets of the port's structure have not been considered in this study because of its focus upon spatial interchanges. A forthcoming paper will deal with other elements of the geography of this port. The theme of spatial interaction which runs through this paper was first expounded by Edward Ullman in a number of studies, particularly "Geography as Spatial Interaction," *Annals*, Association of American Geographers, Vol. 44 (1954), pp. 283–84, *American Commodity Flow* (Seattle, 1957), and in his chapter "Transportation Geography" in P. James and C. Jones, *American Geography: Inventory and Prospect* (Syracuse, 1954), Chap. XIII, pp. 310–32.

[5] It should be noted, however, that in value the outbound shipments accounted for almost two-fifths of the total traffic, reflecting the relatively high value of manufactured goods exported from Genova. *Il Commercio Italiano con l'Estero attraverso il Porto di Genova nel 1955*, Il Valore delle Merci, C.A.P. (Genova, 1957), various pages.

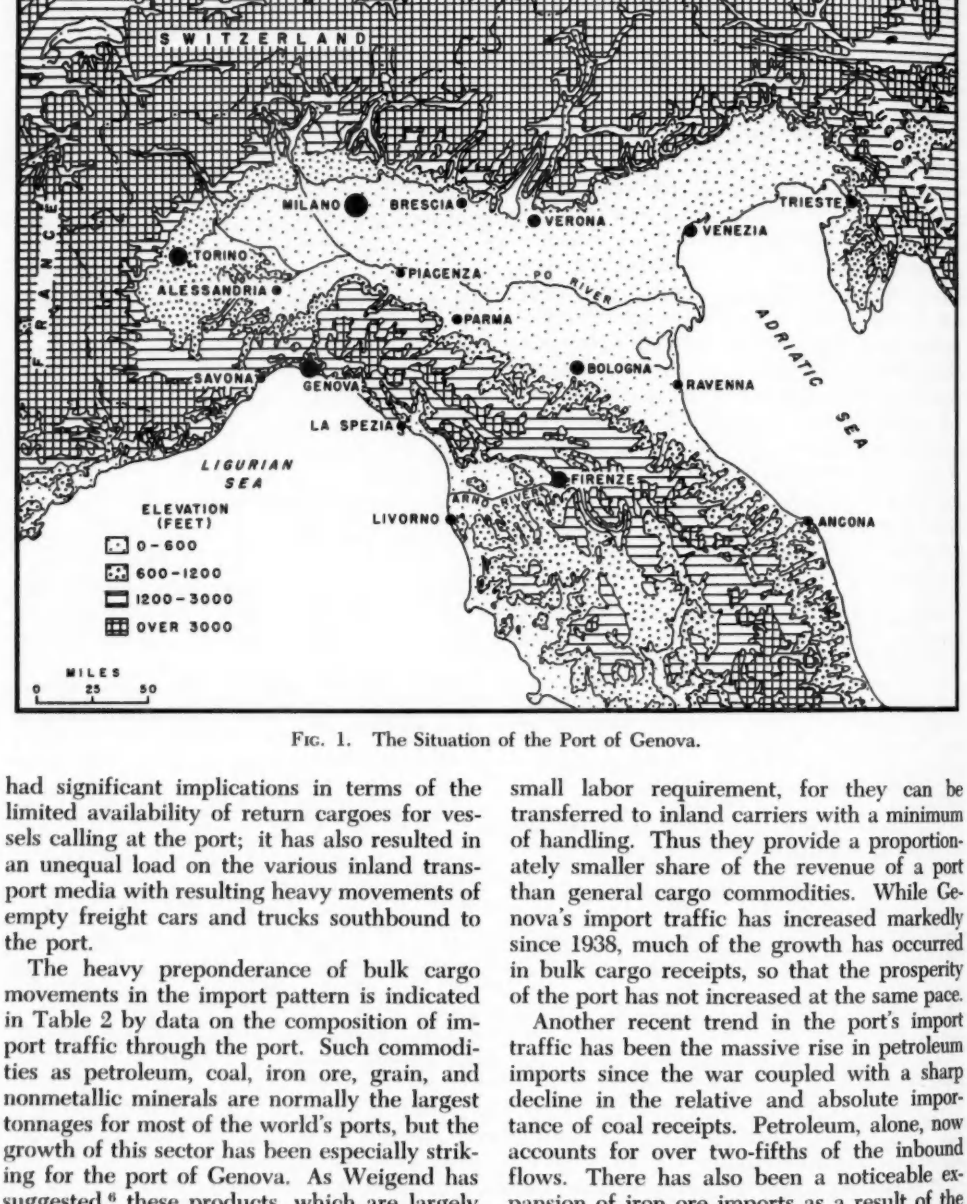

FIG. 1. The Situation of the Port of Genova.

had significant implications in terms of the limited availability of return cargoes for vessels calling at the port; it has also resulted in an unequal load on the various inland transport media with resulting heavy movements of empty freight cars and trucks southbound to the port.

The heavy preponderance of bulk cargo movements in the import pattern is indicated in Table 2 by data on the composition of import traffic through the port. Such commodities as petroleum, coal, iron ore, grain, and nonmetallic minerals are normally the largest tonnages for most of the world's ports, but the growth of this sector has been especially striking for the port of Genova. As Weigend has suggested,[6] these products, which are largely unloaded mechanically, have a relatively small labor requirement, for they can be transferred to inland carriers with a minimum of handling. Thus they provide a proportionately smaller share of the revenue of a port than general cargo commodities. While Genova's import traffic has increased markedly since 1938, much of the growth has occurred in bulk cargo receipts, so that the prosperity of the port has not increased at the same pace.

Another recent trend in the port's import traffic has been the massive rise in petroleum imports since the war coupled with a sharp decline in the relative and absolute importance of coal receipts. Petroleum, alone, now accounts for over two-fifths of the inbound flows. There has also been a noticeable expansion of iron ore imports as a result of the development of basic steel production in the Genova industrial area.

Export movements, which are tabulated in Table 3, have sharply declined over the years.

[6] Guido Weigend, "Some Elements in the Study of Port Geography," *Geographical Review*, Vol. 43, No. 2 (1958), pp. 191–92.

TABLE 2.—IMPORT TRAFFIC OF THE PORT OF GENOVA, 1938 AND 1955[1]

Commodity or commodity group	1938 Thousands of tons	1938 Percent	1955 Thousands of tons	1955 Percent
Bulk cargo				
Coal	2,497	44.0	1,421	13.6
Petroleum	430	7.6	4,248	40.6
Metallic minerals	103	1.8	834	8.0
Grains	309	5.5	419	4.0
Phosphates and fertilizers	189	3.4	271	2.8
Salt	162	2.9	241	2.3
Wine	43	0.8	67	0.4
	3,733	66.0	7,500	71.7
General cargo				
Foods	269	4.6	353	3.4
Chemical products	334	5.9	404	3.9
Wood and wood products	163	2.9	157	1.5
Metal and metal products	604	10.6	1,214	11.6
Textile fibres and cloth	173	3.0	307	2.9
Machinery and parts	9	0.2	34	0.3
Varied	388	6.8	485	4.6
	1,940	34.0	2,954	28.3
Total	5,673	100.0	10,454	100.0

[1] Source: *Relazione Statistica, 1955*, C.A.P. (Genova, 1956), various pages.

TABLE 3.—EXPORT TRAFFIC OF THE PORT OF GENOVA, 1938 AND 1955[1]

Commodity or commodity group	1938 Thousands of tons	1938 Percent	1955 Thousands of tons	1955 Percent
Petroleum products	7	0.4	105	6.6
Coal	84	5.3	1	0.1
Nonmetallic minerals	36	2.3	81	5.1
Stone and clay products	208	13.0	54	3.4
Food products	296	18.5	210	13.1
Wood and wood products	39	2.5	49	3.1
Chemical products	49	3.1	107	6.7
Textile products	104	6.5	134	8.4
Fabricated metals	133	8.3	179	11.2
Machinery and parts	120	7.5	191	11.9
Varied	237	14.7	79	4.8
Bunkers	286	17.9	410	25.6
Total	1,599	100.0	1,600	100.0

[1] Source: *Relazione Statistica, 1955*, C.A.P. (Genova, 1956), various pages.

The only commodities in this sector which have shown appreciable increments are chemicals and refined petroleum, the latter moving in transit through the port. On the other hand, foods, stone and clay products, and the "varied" category (mainly manufactured goods) have all experienced significant relative and absolute reductions.

EXTERNAL RELATIONS

Genova's world-wide maritime relations have been a major element in the functional development of the port, and when viewed in historical perspective, they provide some clues to its future. These interchanges depend on both the requirements of the port's overseas foreland and the demands of its internal hinterland. Table 4 indicates, on a percentage basis, the general external relations of the port of

TABLE 4.—TOTAL VOLUME OF FOREIGN TRAFFIC FOR THE PORT OF GENOVA, IN PERCENT, 1938 AND 1955[1]

Foreland	Over-all 1938	Over-all 1955	Inbound 1938	Inbound 1955	Outbound 1938	Outbound 1955
Western Mediterranean	1.7	4.2	1.8	4.3	2.1	4.3
Eastern Mediterranean and Black Sea	8.3	26.5	5.8	28.4	22.2	14.5
Western and northwestern Europe	51.0	10.5	58.0	10.5	10.5	11.5
Eastern and southern Africa	7.7	3.3	2.0	2.9	40.6	6.4
West Africa	2.5	5.1	2.7	5.1	1.1	5.6
Persian Gulf, Pakistan, India, Ceylon, Indonesia	3.7	11.3	3.8	11.4	2.9	11.6
Far East (Malaya, China, Japan, Philippines)	1.2	2.0	1.0	1.7	2.0	5.0
Australia and New Zealand	0.9	1.6	0.9	1.3	0.6	3.6
Eastern Canada and United States	12.1	25.3	12.7	26.5	8.6	17.3
Western Canada and United States	0.7	0.7	0.7	0.6	0.8	1.4
Central America	4.9	2.5	5.6	2.0	1.0	7.4
Western South America	0.9	1.0	1.0	0.9	1.0	2.0
Eastern South America	4.4	5.0	4.0	4.4	6.6	9.4
Total, percent	100.0	100.0	100.0	100.0	100.0	100.0
tons, in thousands	(5,310)	(9,163)	(4,532)	(8,162)	(788)	(1,002)

[1] Source: *Relazione Statistica, 1955*, C.A.P. (Genova, 1956), various pages.

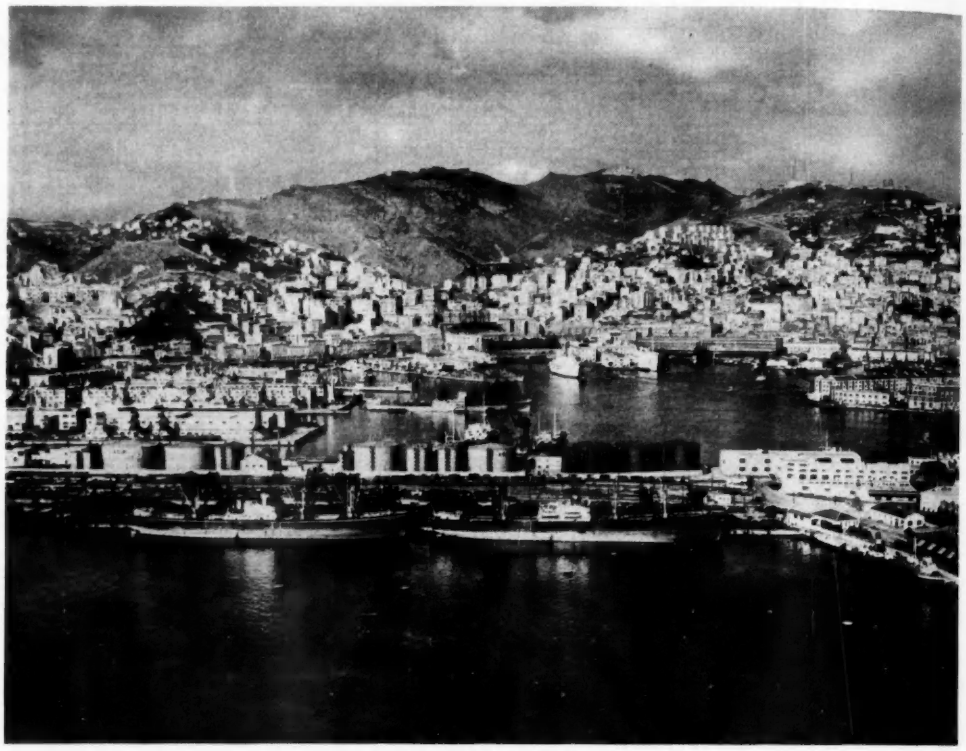

FIG. 2. The Port of Genova.

Genova with foreign areas in 1938 and 1955; these data reveal striking historical changes in origination and destination patterns.

Trends in Inbound Movements

The most important shift in the inbound movements since the war has been the decline of western Europe as a source of traffic for Genova. In 1938, almost three-fifths of the inward flows originated in that area, while in 1955 they accounted for only one-tenth of the total. On the other hand, the relative importance of Anglo-American originations has more than doubled, with this area now accounting for over one-fourth of the inbound movements. These shifts reflect the reduction of coal imports from Great Britain and secondarily Germany, and the rise of coal imports from the United States; this pattern is not unusual, for it parallels trends in other consumption centers in western Europe. In addition, as stressed earlier in this paper, the radical shift from coal to petroleum has been the prime factor in the increase of shipments from the Eastern Mediterranean and Persian Gulf regions which now account for about two-fifths of the originations.

Trends in Outbound Movements

As for the outbound flows from the port of Genova, the destination patterns have also registered marked historical permutations. East Africa, which before the war, as an Italian colonial area, was the destination of two-fifths of the outbound flows, now is a secondary outlet. There has also been a decline of shipments to the Eastern Mediterranean which reflects the loss of Libya as a market for Italian products; this has been partially compensated for by increased movements to other destinations in the eastern Mediterranean. The largest relative growths have been registered in the flows to the Americas and Asian destinations. These increases reflect expanding markets for Italian paper products, machinery, and chemicals.

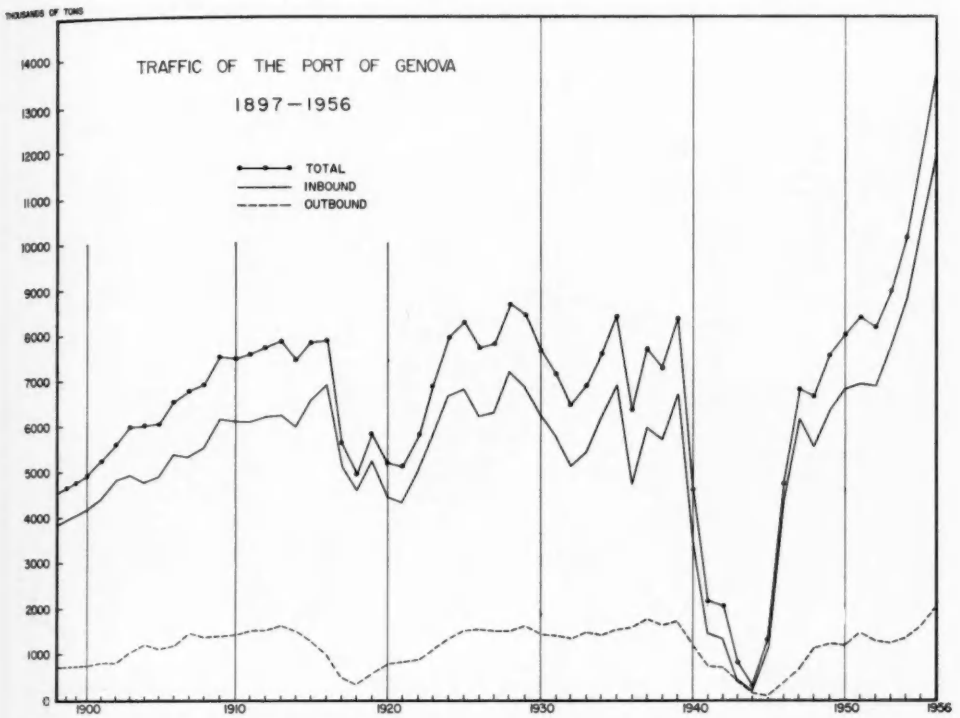

FIG. 3. The Traffic of the Port of Genova 1897–1956. Compiled from the Records of the Consorzio Autonomo del Porto di Genova.

Trends in Coastwise Movements

Table 5 presents the coastwise movements of traffic for Genova in 1938 and 1955; they are a significant sector of the external relations of the port. In the overview, coastwise traffic has grown rapidly in the postwar period, increasing from one-and-two-thirds to two-and-a-half million tons. The great bulk of the increase has come from the growth in inbound petroleum movements, which have risen by over one-and-a-third million tons and secondarily from an increase in the inward flows of iron ore from Elba and salt from Sardinia. However, the massive increases in these commodities mask a marked decline of coastwise traffic in such categories as coal, construction materials, agricultural raw materials, and a wide range of manufactured goods.

The reduction in the flows of many of these products reflects Genova's loss of position as an entrepôt center. Italian authors[7] have attributed this decline to such factors as the increase in effective speed of sea transport; the greater number of regular lines now serving secondary ports; the increased development of truck traffic in Italy which has made possible direct speedy movement from ship to commercial warehouse or factory thus reducing handling costs; and, finally, government encouragement and subsidization of port development in the less highly developed parts of Italy, particularly in Sicily. It should be emphasized, however, that the decline of coastwise traffic is not unique to Genova; it is also a problem for most of the major ports in western Europe.

The data in Table 5 illustrate the shifts dis-

[7] See, for example, F. Ruffino, "La Funzione del Porto di Genova e la Struttura del suo Traffico," *Bollettino Ufficiale del Consorzio Autonomo del Porto di Genova* (1953), No. 3, pp. 8–10, and M. Trombetta, "Unirisi e Volere," *Le Compere di San Georgio* (December, 1952).

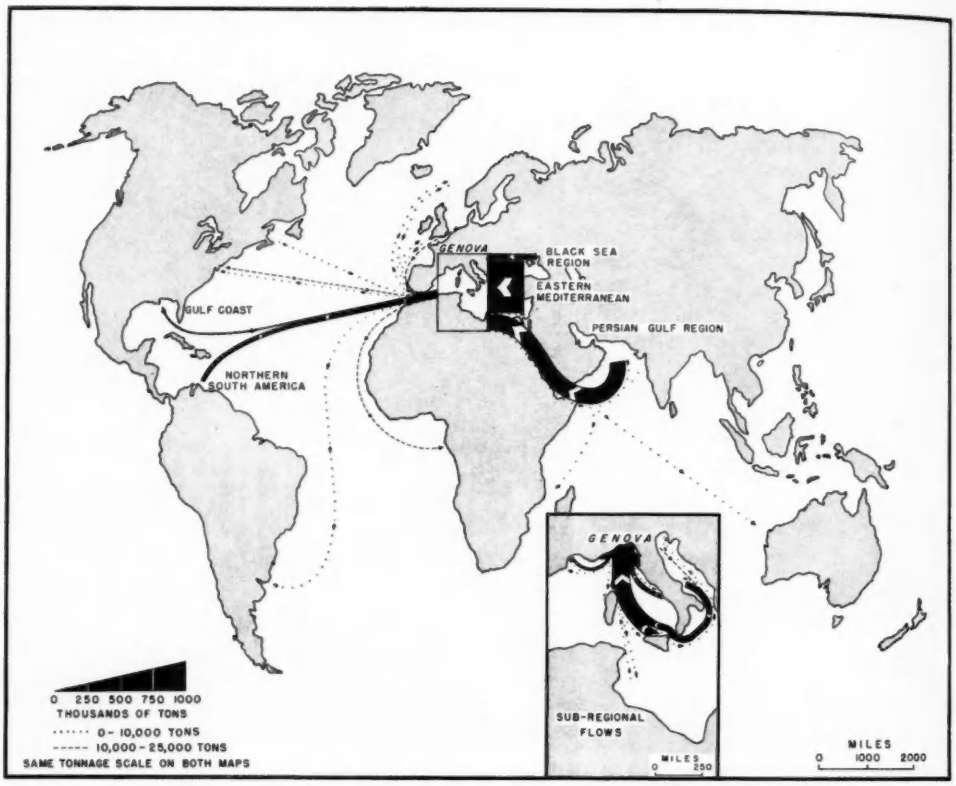

FIG. 4. External Relations of the Port of Genova in 1955: Petroleum Movements. Compiled from *Relazione Statistica, 1955* and *Il Porto di Genova, 1955*, C.A.P., Genova (1956), various pages; the method of representation on Figures 4–6 is patterned after Edward Ullman, *Mobile: Industrial Seaport and Trade Center*, University of Chicago, Ph.D. dissertation (1943), p. 112.

TABLE 5.—COASTWISE TRAFFIC OF THE PORT OF GENOVA, IN PERCENT, 1938 AND 1955[1]

Region	1938		1955	
	Inbound	Outbound	Inbound	Outbound
Western Riviera	3.9	2.3	3.0	26.5
Eastern Riviera	6.0	0.0	23.0	5.8
Toscana	10.6	4.8	20.9	12.7
Lower Tyrrhenia	13.7	11.0	7.9	8.5
Sardinia	23.6	55.2	14.7	39.7
Sicily	20.3	15.6	19.6	3.7
Ionia	3.4	0.0	0.5	0.0
Lower Adriatic	6.6	2.3	8.9	0.5
Upper Adriatic	0.1	3.4	1.0	1.6
Trieste	11.8	5.3	0.5	1.0
Total, percent	100.0	100.0	100.0	100.0
tons, in thousands	(1,143)	(525)	(2,292)	(189)

[1] Source: *Relazione Statistica, 1955*, C.A.P. (Genova, 1956), pp. 27–29.

cussed above. The increased flows from the eastern Riviera (La Spezia), Toscana (Livorno), Sicily (Messina and Catania), and the lower Adriatic (Bari) should be noted. All of these reflect movements of fuel oil to Genova resulting from the corporate structure of the oil industry. The various petroleum companies draw on their refineries in central and southern Italy for petroleum products which are imported through Genova for sale in northern Italy. The growth in receipts from Toscana also reflects the movements of Elba iron ore to the Genova steel industry. Sardinia has increased its movements of salt to Genova while its imports from this port, particularly of manufactured goods, have decreased drastically. The decline of Trieste both in inbound and outbound movements resulted from the change in political status of

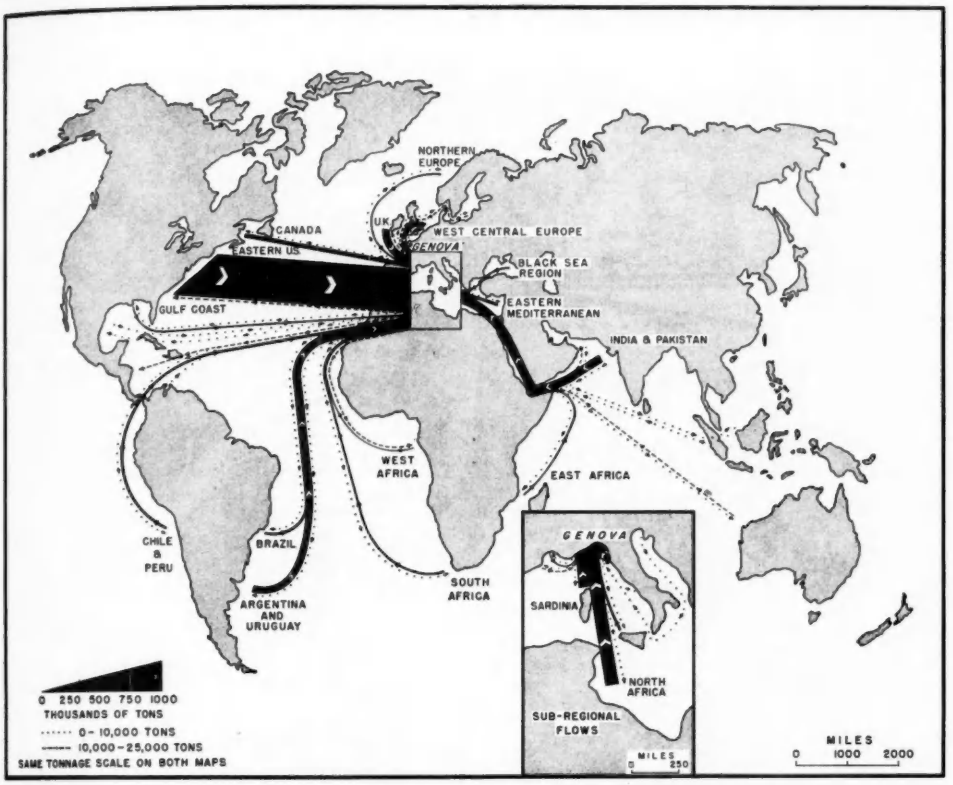

FIG. 5. External Relations of the Port of Genova in 1955: Dry Bulk Movements. Compiled from *Relazione Statistica, 1955*, and *Il Porto di Genova, 1955*, C.A.P., Genova (1956), various pages.

Trieste during this period. Commodity movements to and from Trieste have increased since 1955 as a result of its return to Italian sovereignty.

Present Flow Patterns

Figures 4, 5, and 6 present the external relations of the port in 1955. The map of oil shipments, which comprised more than one-third of Genova's traffic, is relatively uncomplicated. The flows were almost exclusively inbound. The only significant outbound movement was that of petroleum products moving in transit through the port, of which two-fifths were shipped to Savona in the western Riviera, and most of the remainder to other Italian ports. More than two-fifths of the inbound oil movements originated in Lebanon and Syria in the eastern Mediterranean with their pipeline connections to the Middle East oil fields. Other significant flows were registered from Kuwait on the Persian Gulf, Venezuela, and Italian ports, particularly Bari, La Spezia, and Naples. The Italian originations were almost exclusively fuel oil, as explained earlier, while those from other sources were primarily crude oils. Ideally this map should include all liquid bulk flows; however, the detailed data for this breakdown were not available. In a general sense, these movements would include bulk wines from southern Italy and other Mediterranean centers, plus animal fats from the United States, linseed oil from the Plata region, palm oils from West Africa, and coconut oils from western India.

Figure 5 presents the movements of dry bulk commodities, which accounted for about two-fifths of the total traffic of the port of Genova. Here again the movements were predominantly inbound, with the most important

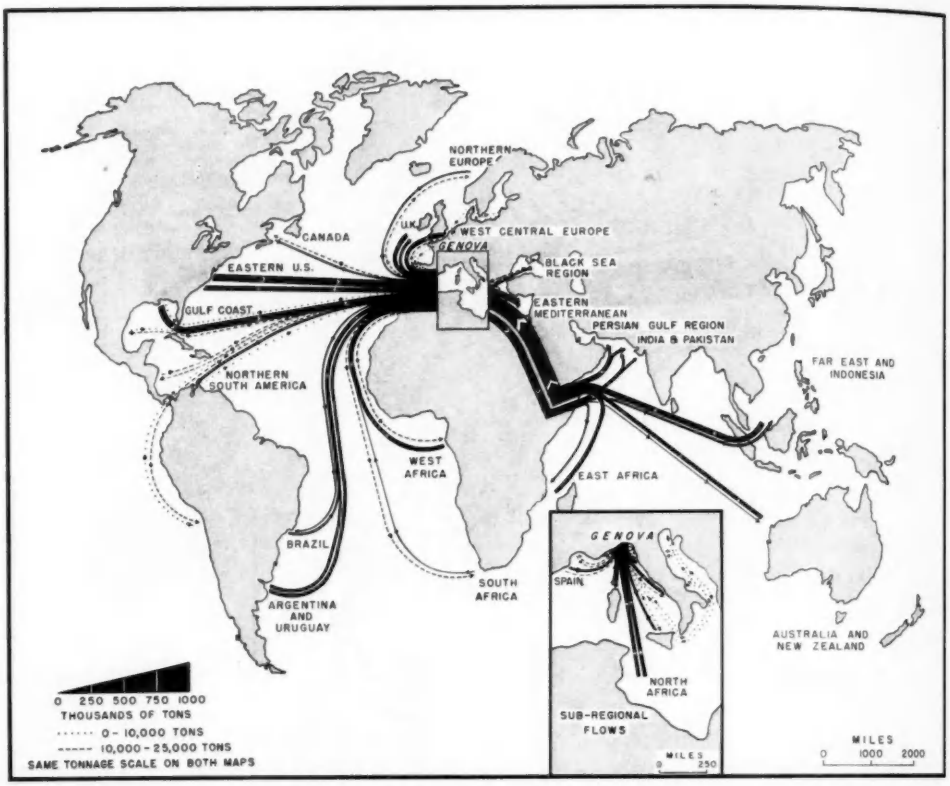

FIG. 6. External Relations of the Port of Genova in 1955: General Cargo Movements. Compiled from *Relazione Statistica, 1955*, and *Il Porto di Genova, 1955*, C.A.P., Genova (1956), various pages.

flows from the United States and significant secondary movements from Northwest Europe, Southwest Asia, North Africa, and South America. The flows from the United States, which accounted for roughly two-fifths of the dry bulk traffic, consisted primarily of coal from Norfolk and scrap iron and steel from New York and Philadelphia. Coal was also the chief dry bulk movement from northwest Europe, originating primarily in England, with secondary flows from the Benelux area, western Germany, and Poland. India provided major shipments of iron ore, while North Africa (French Morocco and Tunisia) was a major source of phosphates and iron ore. The South American flows are diverse, but the most significant movements in 1955 were the receipts of Argentine grain and Chilean and Brazilian iron ore.

The general cargo map, Figure 6, is the most complicated of the three. Manufactured goods comprise the bulk of this traffic, which represents about one-fourth of the total flows. The map evidences major outbound as well as inbound flows. However, the latter are still twice as strong as the outbound traffic. The regional patterns are quite diverse, but the broad lineaments are significant and can be summarized here.

Roughly one-fifth of the general cargo movements were flows between Anglo-America and Genova, the predominant movements inbound to the port. The major receipts from this area comprised industrial raw materials, such as cotton and animal fats, as well as such manufactured goods as chemicals, metal products, and machinery. Shipments from Genova to this region consisted of a wide variety of food products, leather goods and textiles, metal products, machinery, and motor ve-

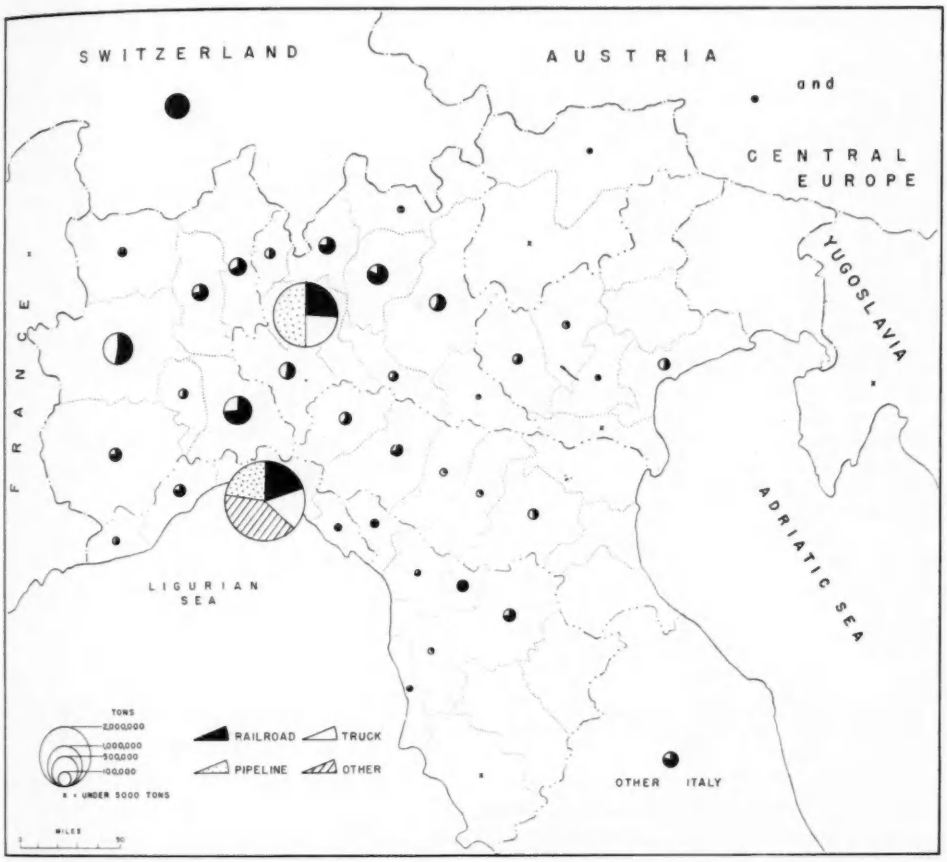

FIG. 7. Internal Traffic Flows of the Port of Genova, 1954, by Type of Carrier. Compiled from the records of the C.A.P.

hicles. The ties with western Europe were very similar except for the absence of cotton in the receipt pattern; inbound flows again predominated. All told, reciprocal relations with this area accounted for about fifteen percent of the general cargo movements. Flows to and from the other Italian ports accounted for one-ninth of these movements; their composition was extremely diverse.

The ties with Latin America, Africa, Asia, Australia, and New Zealand represent approximately half of the movements shown on Figure 6. Imports from these areas consisted of agricultural raw materials and foodstuffs. Some of the major items included were cotton, wool, hides and skins, copra, various oil seeds, rubber, coffee, tea, cacao, sugar, and bananas. The export flows were, in tonnage, less significant, and in composition they were similar to the movements from Genova to western Europe and Anglo-America.

In the overview, recent trends in the external relations of the port of Genova indicate a marked strengthening of ties with Anglo-America and Southwest Asia. Connections with the Middle East will undoubtedly increase in relative importance with anticipated growth in Italian demand for petroleum products. The expansion of the Italian steel industry, particularly that in the Genova area, should stimulate increased imports of scrap from the eastern United States and iron ore from India and Latin America. Genovese exports are widely disseminated geographically;

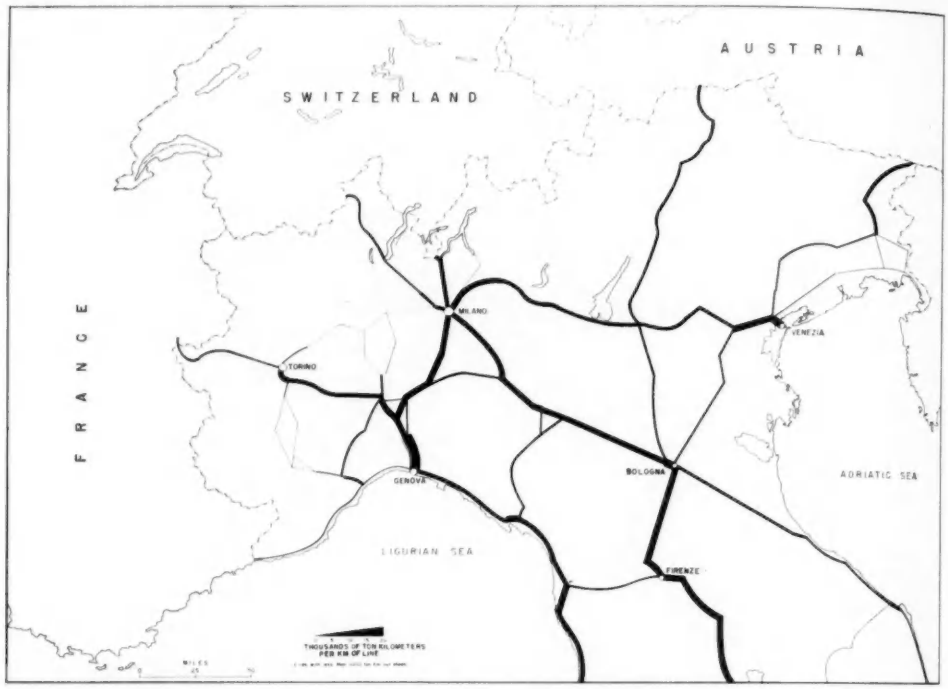

FIG. 8. Rail Traffic Flow, Average Daily Movement, in Northern Italy in 1953. Compiled from data in *Graduatoria delle Linee Statistiche, 1953*, Ferrovie dello Stato, Rome, Italy (1954).

thus it is difficult to forecast future patterns. It should be noted, however, that United States markets for Italian products, particularly in the consumer goods category, have increased at a faster pace than in other *major* consuming centers. If this pattern prevails, its impact on Genova's outbound traffic should be considerable.

INTERNAL RELATIONS

The relations between Genova and its hinterland constitute another major element in the geography of the port. The volume and character of these spatial interchanges depend in part on the nature and demands of this service area, existing routes and connections between the hinterland and the port, and the position of Genova in relation to other competing ports. In the ensuing analysis, these internal relations are viewed with respect to volume and direction of flow, commodity structure, and historical trends.

In 1954 approximately seven million tons of goods were shipped from the port of Genova by rail, truck, and pipeline to various inland destinations. In addition almost one-and-a-half million tons were debarked directly by ship at commercial storage facilities, industrial plant docks, bunkerage depots and direct transfer to other vessels in the port. Movements from the hinterland to Genova totalled one-and-a-third million tons including ship bunkerage and supply.[8]

The share of the various carriers in the traffic pattern in 1954 is given in Table 6, and the regional distribution patterns of these flows are shown on Figure 7. In the postwar period, the share of truck traffic has increased rapidly, while the railroad's portion has steadily declined. However, since 1954 there has been a slight reversal of this pattern largely as a result of preferential rates afforded by the government-owned railways. Another significant recent change in the over-all move-

[8] These data do not correspond to the import and export statistics for 1954. During that year the imports of the port of Genova totalled 8,780,596 tons and exports were 1,339,864 tons.

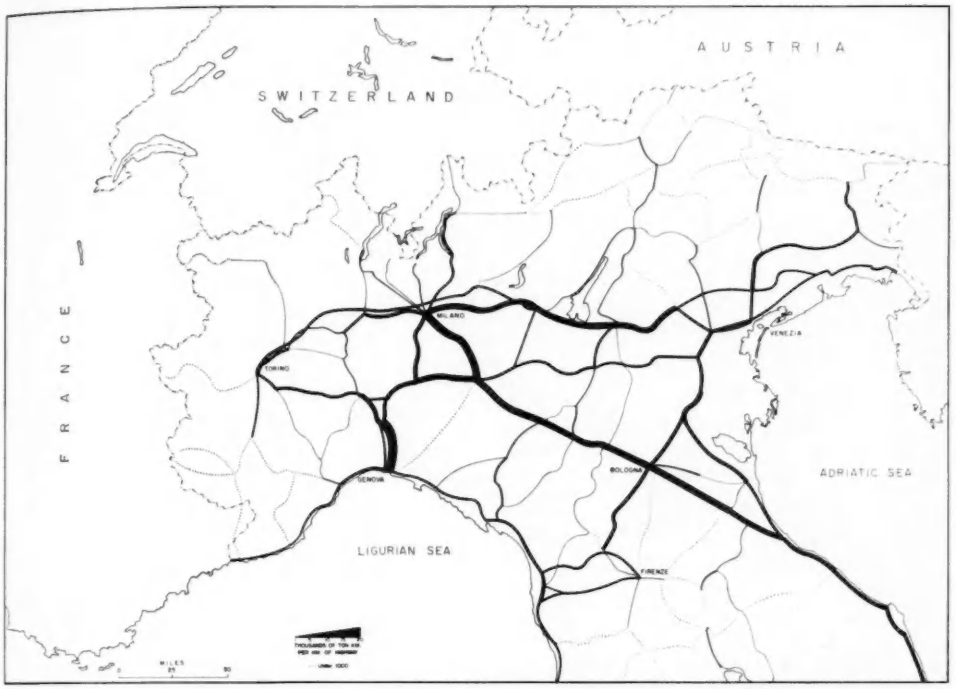

FIG. 9. Truck Traffic Flow, Average Daily Movement, in Northern Italy in 1954. Compiled from data in *Statistica Nazionale sull Autotrasporto di Cose,* Ente Autotrasporti Merci, Rome, Italy (1955), and other studies made by this association.

TABLE 6.—INTERNAL FREIGHT TRAFFIC, BY CARRIER, FOR THE PORT OF GENOVA IN 1954[1]

Carrier	Freight traffic handled	
	Tons	Percent
Rail	3,746,000	38.2
Truck	2,211,000	22.5
Pipeline	2,084,000	21.2
Other[2]	1,771,000	18.1
Total	9,812,000	100.0

[1] Source: Compiled from the records of the C.A.P.
[2] "Other" includes the methods of direct debarkation discussed earlier.

ments has been the rapid rise of oil flows consequent on the construction of pipelines to Fegino (north of Genova) in 1951, and to Rho, near Milano, in 1953. Direct debarkation by ship has also increased massively since 1952 with the opening of the Molo Ronco, in the western part of the port, for receipts of raw materials for the steel complex at Cornigliano.

There appears to be no significant correlation between distance of shipment and the use of trucks, aside from movements within the Genova industrial area. Regional variations in the pattern, however, are apparent, such as the greater significance of rail traffic movement to the southeast and west due to the poor road network leading from Genova in these directions. The proportionately greater importance of truck traffic to the north and east in the reverse sense reflects superior highway connections with these areas. Rail lines dominate in the flows of heavy bulk commodities other than petroleum, while trucks are the basic carriers of general cargo goods. Figures 8 and 9 indicate the patterns of rail and truck traffic in northern Italy in 1953 and 1954, respectively. The flows on the two maps are remarkably similar, reflecting to a large degree topographic restrictions. The limited traffic in the coastal regions both east and west of Genova should be noted, as well as the heavy movements on

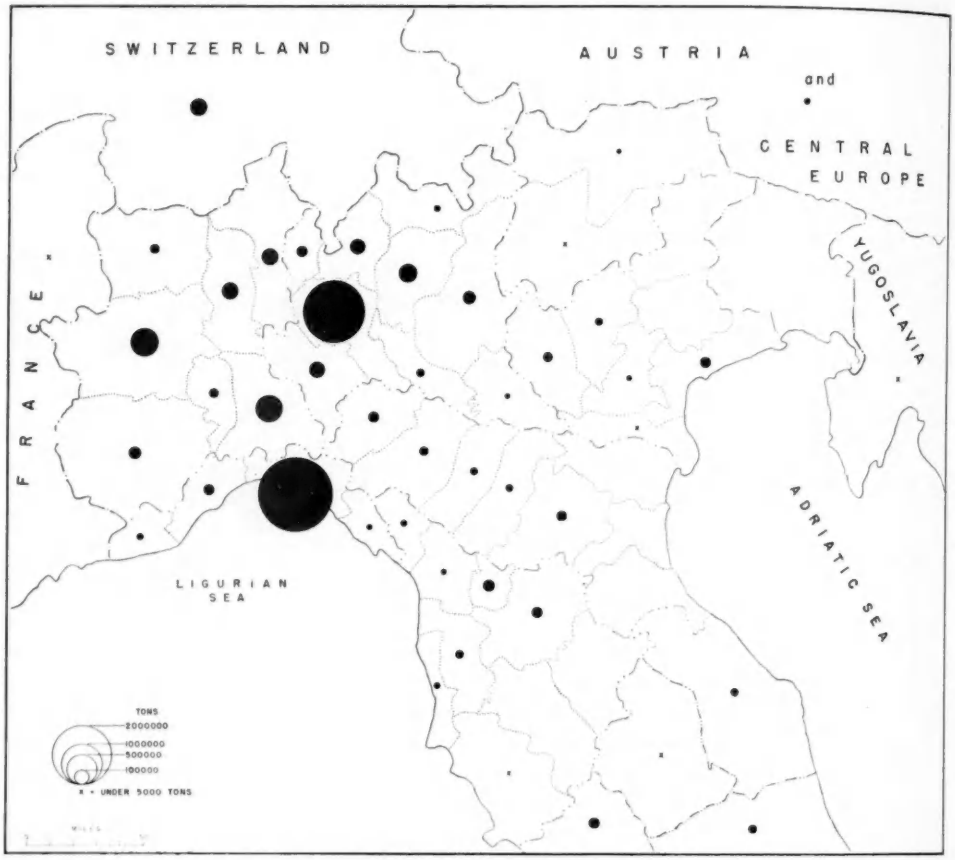

FIG. 10. Inbound Movements through the Port of Genova, by Province, in 1954. Compiled from the records of the C.A.P.

the main routes to the industrial centers of the Po Valley.

Inbound Movements

Commodity movements into the interior are presented on Figure 10. On this map two provincial centers dominate the traffic pattern: Genova in Liguria and Milano in Lombardia, accounting in all for over two-thirds of the tonnage. If Torino and Alessandria in Piemonte are included, the share of these four centers is almost four-fifths of the total inbound movements. Foreign destinations received less than four percent of the inbound flows, and these were predominantly in southern Switzerland. Figure 11 provides some comparative distributional data on the percentages of population, industrial employment, and traffic generation for all ports by the major Italian regions. It can be seen that although Liguria, Piemonte, and Lombardia together contain only about a sixth of the area and one-fourth of the population of Italy, these regions account for almost two-fifths of the traffic generation and approximately one half of the country's employment in manufacturing. Other measures would also point up the great economic significance of this key core area.

Figures 12 to 15 present the inbound movements for selected commodities from the port of Genova in 1954. The regional patterns vary considerably, and their interpretation will provide some clues to an understanding

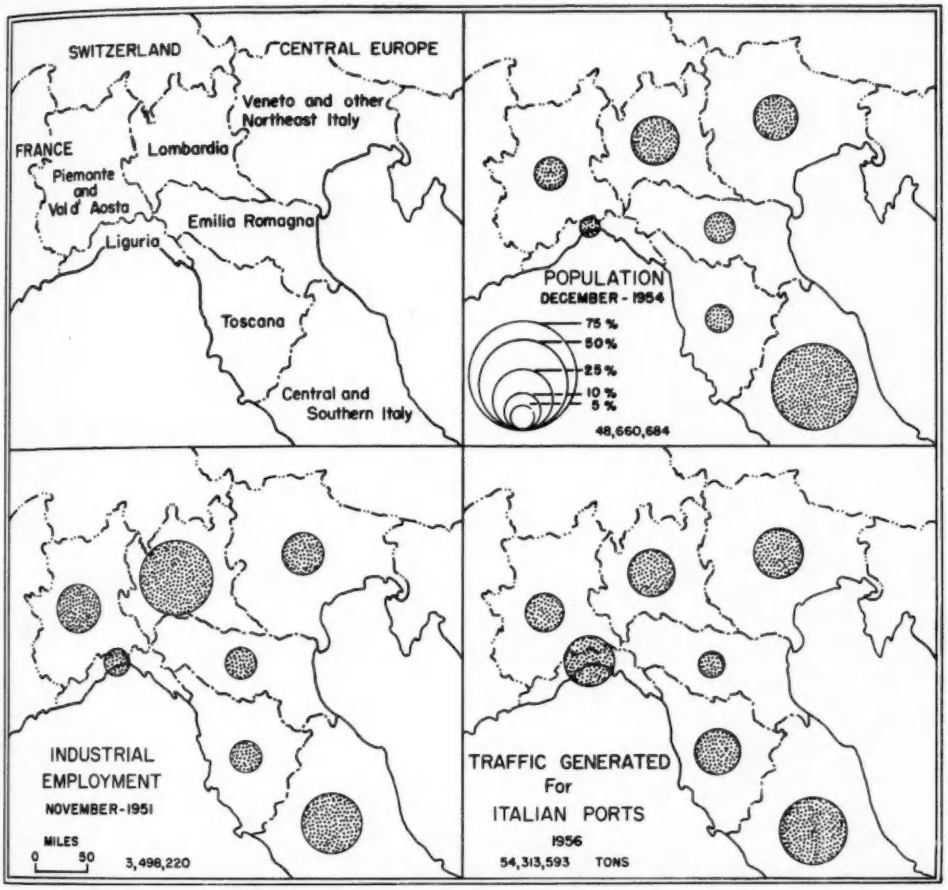

FIG. 11. Comparative Distributional Data. Scale on the three statistical maps is the same. The population data were compiled from *Annuario Statistico Italiano, 1955*, Rome, Italy (1956), p. 119; the industrial employment data were found in *Risultati Generali per Comune*, III Censimento Generale dell Industria e del Commercio, Vol. 1, 1951, Rome, Italy (1954), various pages; traffic generated for ports from data provided by the Sezione Navigazione of the Istituto Centrale di Statistica, Rome, Italy (1957).

of the functional characteristics of the port.

The most important flows, as indicated earlier, were those of the various minerals, which are shown on Figure 12. All told, they accounted for almost two-thirds of the inbound tonnages; in value, however, their share was of course less significant.

Petroleum and petroleum products are of key importance for they represented two fifths of the total inbound movements.[9] The data show that about half of the petroleum flows, both crude and refined, moved to Ligurian destinations and these almost exclusively in the Genova industrial region. About two-fifths of the total was destined for Lombardia, predominantly the Milano area, and the bulk of the remainder moved to industrial centers in Piemonte. The increase in petroleum shipments in recent years is attributable both to increased demand in northern Italy resulting from industrial growth and to the replacement of coal by oil in the energy requirements of this area.

While coal has declined in relative and absolute importance, it is still a significant

[9] Movements of petroleum and petroleum products are discussed in greater detail in the last part of this paper.

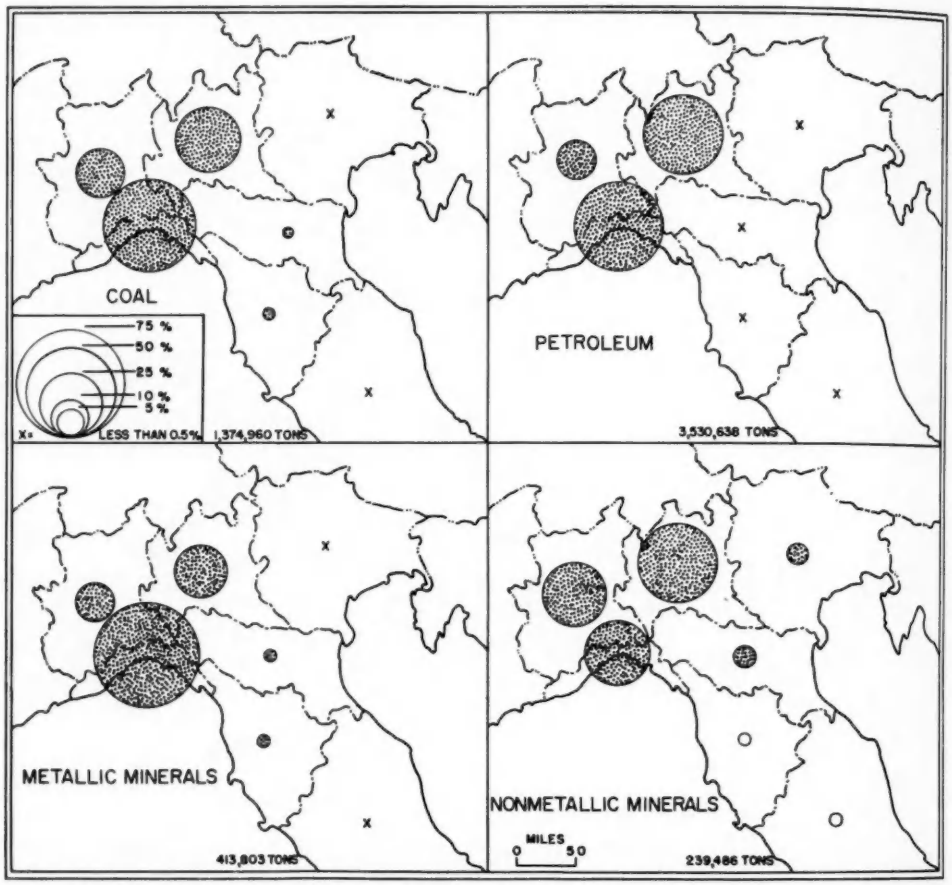

FIG. 12. Inbound Movements by Commodity Group in 1954. Compiled from *Relazione Statistica, 1955,* and *Bollettino Mensile di Statistica* (December 1954), various pages, C.A.P., Genova, Italy.

item in inbound movements. Liguria received well over half of the coal in 1954, and this was destined for consumption in the Genova industrial area. The largest share was directly debarked at the Molo Ronco for the new Cornigliano steel mill, and much of the remainder was consumed in thermo-electric facilities in the port. Domestic consumption of coal in this area has declined sharply in the past few years as a result of the construction of a pipeline southward from the natural gas fields of the Po Valley. Significant shipments of coal also move inbound to the urban centers of Lombardia and only secondarily to Piemonte, for this area receives much of its coal via the port of Savona (see Fig. 1).

Metallic minerals constituted another major group of inbound movements with the largest share destined for the Genova area. The chief commodity in this category was iron ore, and it moved to the Cornigliano mill. The remaining flows, manganese, ilmenite, and chrome, were destined for steel mills in Lombardia and secondarily Piemonte and Val D'Aosta. Another large-tonnage, low-value group was that of the nonmetallic minerals. Here the main shipments consisted of limestone for Cornigliano and salt destined for chemical plants in the Milano area. Movements to Piemonte are complex, both in type and destination; all told these account for one-fourth of the total.

Scrap shipments shown on Figure 13 are also of major importance. Well over two-fifths

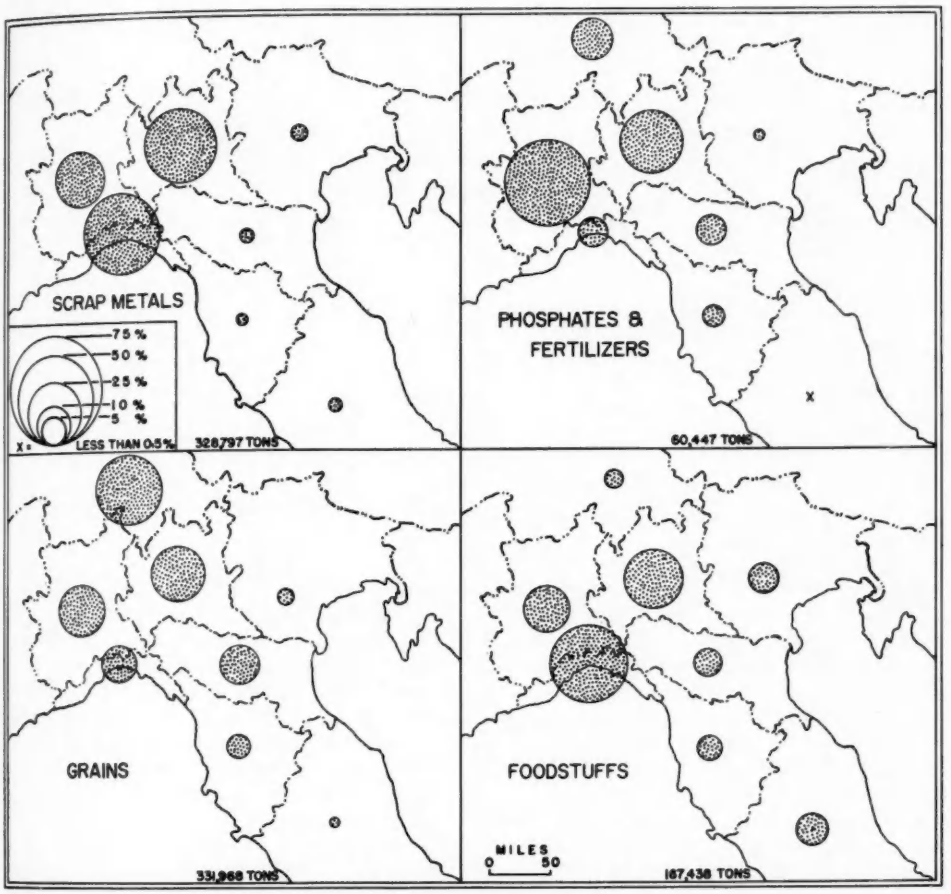

FIG. 13. Inbound Movements by Commodity Group in 1954. Compiled from *Relazione Statistica, 1955,* and *Bollettino Mensile di Statistica* (December 1954), various pages, C.A.P., Genova, Italy.

of the flows moved to iron and steel mills in the Genova area, while the remainder moved mainly to steel plants in the Milano area. Shipments of phosphates and other fertilizers are shown on the same series of maps. The great bulk moved to chemical plants scattered through the agricultural centers of the Po Valley. Piemonte stands out in this pattern because of the concentration of the Montecatini Company superphosphate factories in its regional centers of Vercelli, Novara, and Voghera. Over one-tenth of the inbound tonnages moved to Swiss destinations. Liguria is of minor importance, because of the limited development of agriculture in the Genova area.

The grains stand out as a key import among the movements of agricultural raw materials and foodstuffs. Imports of grain, however, have declined materially since the twenties when an extremely low tariff policy applied to this product. Today, not only are imports restricted by tariff provisions, but within Italy the distribution is largely determined by the State. The flow pattern on Figure 13 shows a heavy movement to Swiss destinations; internally it is rather dispersed in rough accordance with distance from the port and the distribution of the northern flour milling industry. Shipments of foodstuffs show the importance of Genova as a break of bulk center, with roughly two-fifths of the movements

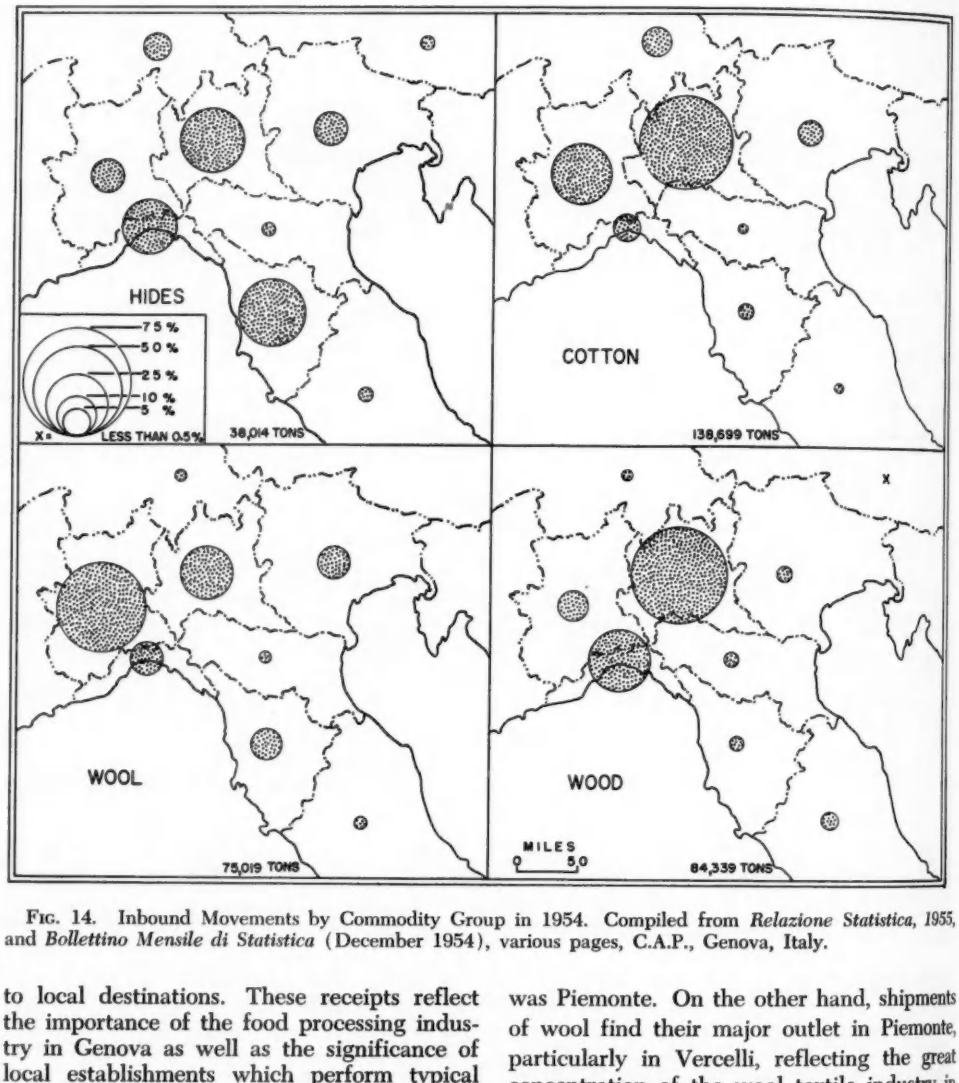

FIG. 14. Inbound Movements by Commodity Group in 1954. Compiled from *Relazione Statistica, 1955,* and *Bollettino Mensile di Statistica* (December 1954), various pages, C.A.P., Genova, Italy.

to local destinations. These receipts reflect the importance of the food processing industry in Genova as well as the significance of local establishments which perform typical commercial functions prior to the redistribution of foodstuffs to the urban centers of the north. Otherwise the pattern is relatively dispersed.

There is a rather striking difference between the cotton and wool shipment maps presented on Figure 14. Three-fifths of the raw cotton moved to Lombardia, the chief focus of the Italian cotton textile industry; within this region the main flows were to such centers as Milano, Brescia, Como, and Bergamo. The only other significant destination was Piemonte. On the other hand, shipments of wool find their major outlet in Piemonte, particularly in Vercelli, reflecting the great concentration of the wool textile industry in this region. Movements of hides are much more widely dispersed. This raw material moved to the centers of the Italian tanning industry, both in the Po Valley and also in Toscana, at Pisa and Firenze. The last of the maps on Figure 14, that of wood, reflects major movements of exotic woods to the furniture industry in Lombardia, particularly to Milano and Como. Shipments to Genova, which accounted for one-fourth of the total, indicate the importance of the local furniture

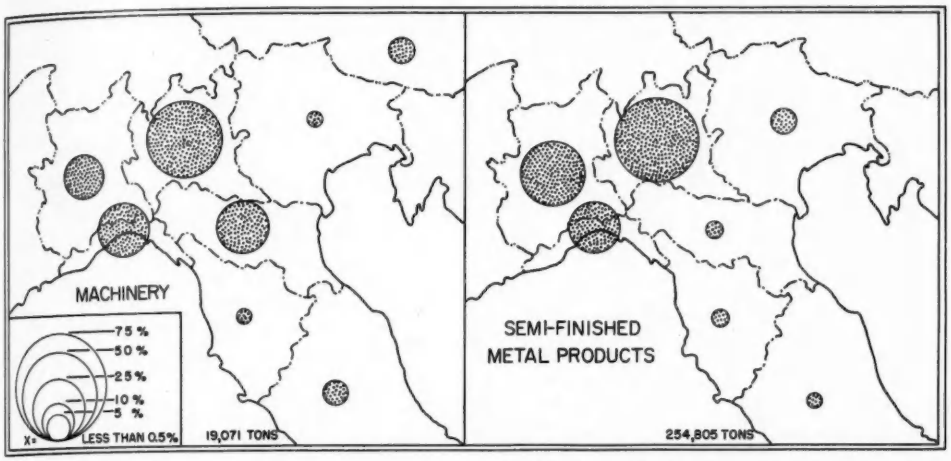

FIG. 15. Inbound Movements by Commodity Group in 1954. Compiled from *Relazione Statistica, 1955,* and *Bollettino Mensile di Statistica* (December 1954), various pages, C.A.P., Genova, Italy.

industry as well as warehouse receipts for eventual movements to the interior.

The maps on Figure 15 show the flows of semifinished metal products and machinery into the Genovese hinterland. For the former, the distribution pattern follows the concentration of the steel industry in Lombardia, Piemonte, and Liguria. These semifinished metal commodities, which in American steel parlance are designated as hot rolled products, in most instances require further finishing in metallurgical plants. Although the distribution of machinery exhibits roughly the same pattern, only two-thirds of the receipts were registered in the areas noted above.

TABLE 7.—TRENDS IN THE REGIONAL PATTERNS OF INBOUND MOVEMENTS THROUGH THE PORT OF GENOVA, IN PERCENT, 1928 TO 1955[1]

Destination	1928	1934	1953	1954	1955
Lombardia	36.6	43.7	29.3	34.4	31.8
Piemonte	31.8	26.7	17.1	15.9	15.3
Liguria	22.9	23.5	41.5	40.0	44.2
Veneto	n.a.	n.a.	1.6	1.3	1.1
Emilia	6.7	2.9	3.1	2.0	2.1
Toscana	n.a.	n.a.	2.2	1.8	2.0
Southern and central Italy	n.a.	n.a.	1.2	1.2	1.1
Foreign	2.0	3.2	4.0	3.4	2.4
Total	100.0	100.0	100.0	100.0	100.0

[1] Source: 1953–55 data were secured from the records of the C.A.P.; the data for 1928 and 1934 were compiled from Juja, *op. cit.*, various pages. N.a. = not available.

Emilia also stands out as a significant destination, with one-fifth of the movements. While rail lines are the chief carriers for shipments of semifinished metal products, machinery moved mainly by truck.

Partly because of space limitations but also because of the absence of detailed distributional data, no attempt will be made here to outline the flows of the dozens of additional products shipped inland to Italian and foreign destinations. These commodities are largely manufactured goods, and, in comparison with the products treated above, their destinations are relatively widely dispersed in greater accordance with the distribution of consumer markets in northern Italy.

Trends in Inbound Movements

The data in Table 7 reveal rather sharp historical contrasts in the inbound flows of commodities to the Genovese hinterland. Although the patterns have been relatively stable since 1953, the changes since 1928 are striking. Liguria's share of the inbound movements has almost doubled since that date, and the local area now accounts for 44 percent of the shipments. This increase offsets relative declines in both Piemonte and Lombardia.

These shifts reflect a significant change in the function of the port. In the twenties, Genova was basically a transit port. Today it must be classified as a major break of bulk center with processing industries, which have

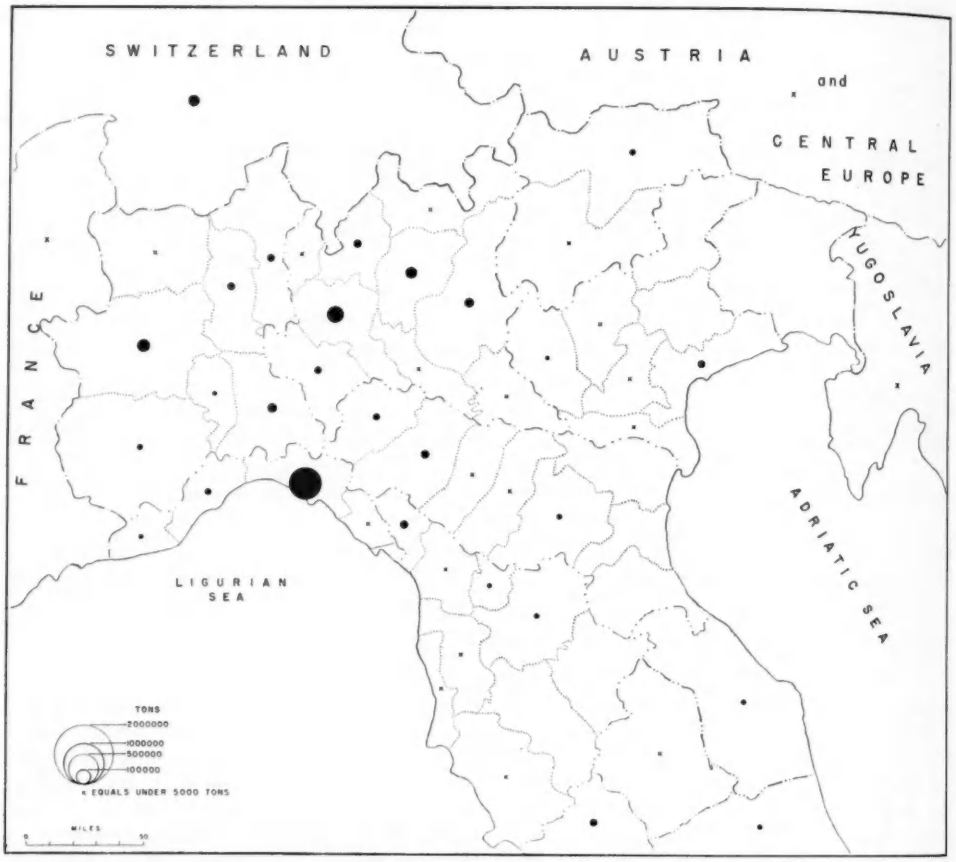

FIG. 16. Outbound Movements through the Port of Genova, by Province, in 1954. Compiled from the records of the C.A.P.

grown at an extremely rapid pace, whose end products are destined for further fabrication within its hinterland or for direct consumption in this supporting area.

While no attempt can be made here to outline all of the historical changes in commodity movements, an analysis of the movements of eleven products or product groups from 1928 to 1955 indicates a marked strengthening of Ligurian receipts of commodities designed for consumption in its steel mill complex, such as iron ore, scrap, limestone, and coking coal (as opposed to steam coal). In addition there has been the tremendous increase in oil movements to Genova discussed previously. On the other hand, there has been a reduction in grain receipts, which has been a factor in the decline of the local flour milling industry; diminution in the Ligurian share of hide shipments which has been associated with the decline of the Genova tanning industry; and finally a reduction in local receipts of vegetable oils and nuts with a complementary decrease in employment in the vegetable oil industries. With respect to the flows to centers in the Po Valley, major increases have been recorded in shipments of petroleum paralleled by a decline in movements of coal.

Outbound Movements

Movements from the interior to the port of Genova are shown on Figure 16. These flows represented only one-seventh of the total hinterland traffic, and they were relatively

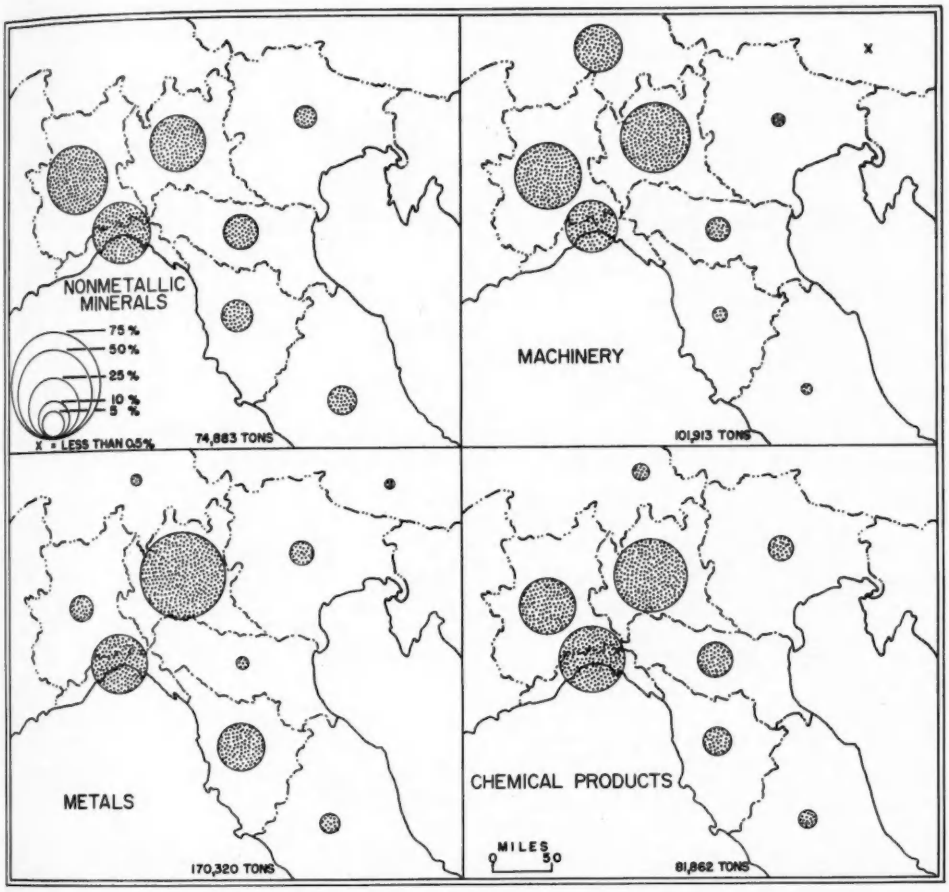

FIG. 17. Outbound Movements by Commodity Group in 1954. Compiled from *Relazione Statistica, 1955,* and *Bollettino Mensile di Statistica* (December 1954), various pages, C.A.P., Genova, Italy.

dispersed compared to those on the inbound map (Fig. 10). The two major centers, Genova and Milano, however, still accounted for more than half of the total. Genova alone originated 45 percent of the export movements, if bunkerage flows are included. Receipts from foreign areas were of secondary importance, representing less than four percent of the outbound traffic.

Selected commodity movements by geographical origin are shown on Figures 17 and 18. The flows of nonmetallic minerals shown on Figure 17 were strongly concentrated in the core area. The most significant flows in this group were talc from Torino and fluorite from Brescia and Bergamo in Lombardia. Movements from Liguria were composed mainly of materials which had originated in the interior and were stored in Genova warehouses for eventual overseas shipment.

Almost half of the flows of metal goods, shown on the same series of maps, came from the major metallurgical centers in Lombardia. A large share of the receipts consisted of hot-rolled products, like sheets and plate from the Falck mills in Sesto San Giovanni and Milano, and pipe from the Dalmine works near Bergamo. Other significant movements were those originating in the Piombino mills in Toscana and the Siac and Cornigliano works in the Genova industrial area.

The receipts of machinery show a signifi-

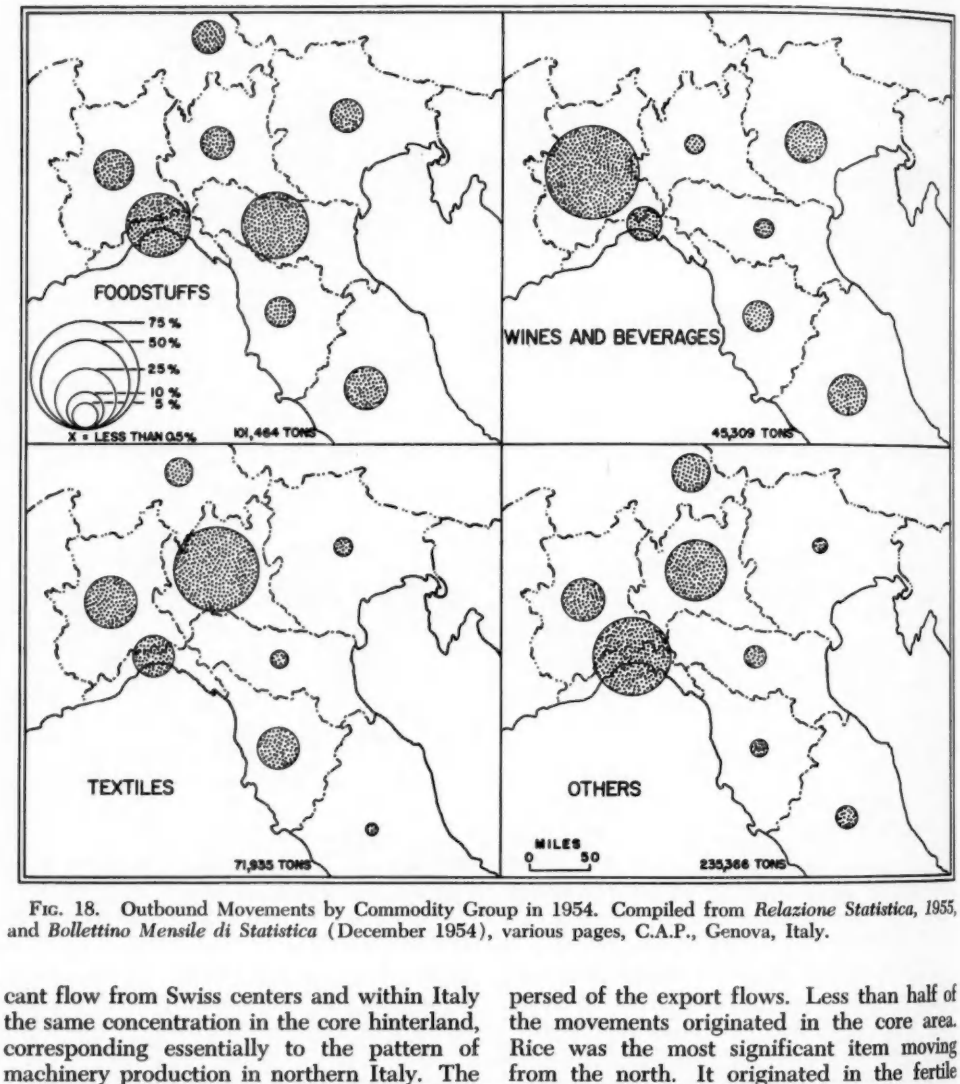

FIG. 18. Outbound Movements by Commodity Group in 1954. Compiled from *Relazione Statistica, 1955,* and *Bollettino Mensile di Statistica* (December 1954), various pages, C.A.P., Genova, Italy.

cant flow from Swiss centers and within Italy the same concentration in the core hinterland, corresponding essentially to the pattern of machinery production in northern Italy. The last map on Figure 17, that of chemical products, exhibits the same pattern with the exception of an absence of foreign receipts. Industrial fertilizers were the chief items moving from Piemonte, while those from Liguria consisted of soaps and paint products produced in Genova's industrial plants. Shipments from Lombardia were composed of a whole range of chemical goods and pharmaceuticals originating mainly in Milano.

The pattern of receipts of food products, shown in Figure 18, is probably the most dispersed of the export flows. Less than half of the movements originated in the core area. Rice was the most significant item moving from the north. It originated in the fertile lowlands of Vercelli and Novara in Piemonte, and the Pavia and Milano districts of Lombardia. The main shipments from Emilia were canned tomatoes from the horticultural areas near Piacenza. Liguria's role in this pattern can be explained in part by the existence of numerous food processing plants in the Genova area which specialize in the production of olive oil and canned fish; a large share of the markets for these firms lies in the areas of Italian settlement in the Americas. Piemonte was the most important source of

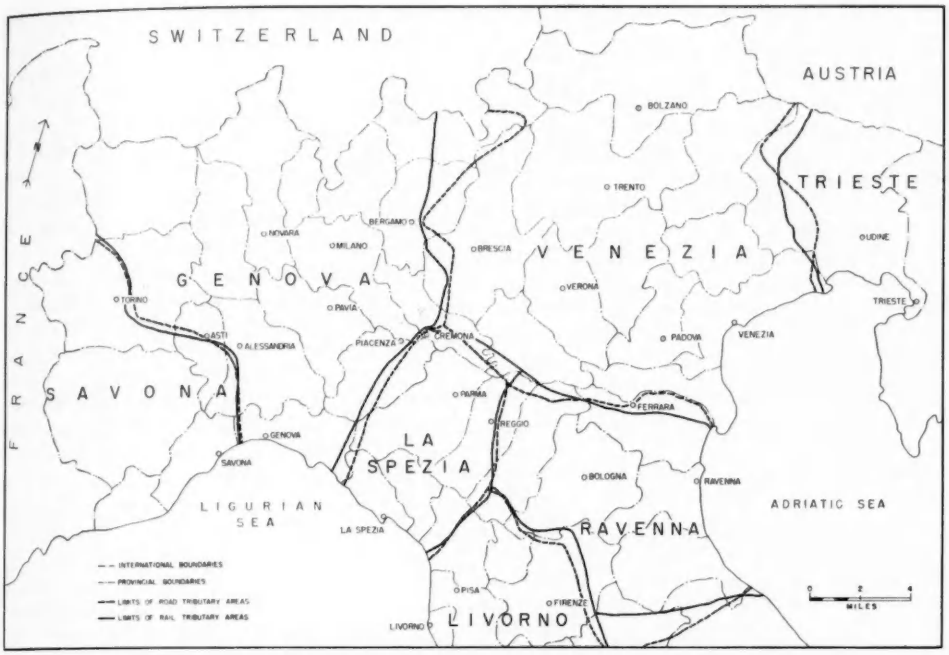

FIG. 19. Rail and Highway Tributary Areas for Northern Italian Ports.

wines and liquors with major flows from both the Asti and Alessandria districts.

Finally, the map of textile products reflects the concentration of the Italian cotton textile industry in Lombardia, with this area accounting for almost half of the originations. Significant movements were also recorded from Piemonte, Toscana, and Liguria.

Trends in Outbound Movements

No data, unfortunately, are available for an analysis of long-term trends in outbound flows of goods from the Genovese hinterland. Jaja attempted to outline the general pattern in 1928 through an analysis of the composition of the traffic and his knowledge of the economic character of the tributary area. The data presented in his study indicate that as of that date one-third of the flows originated in the port area and did not require any movement by rail; these included bunkerage, and direct receipts from commercial and industrial facilities within the port. By 1954, Liguria accounted for almost half of the flows and practically all of these receipts originated in the Genova industrial area.

It is evident from Table 8 that the regional patterns were comparatively stable from 1953 to 1955 with slight relative reductions in the receipts from Liguria and Toscana and corresponding increases in those from the Po Valley. The decline of Ligurian originations reflects the depressed industrial conditions in this area during those years. An analysis of individual commodity movements during this period indicates roughly the same regional trends with most of the products exhibiting slight decreases in Ligurian originations and increases in those from Lombardia and Piemonte.

TABLE 8.—TRENDS IN THE REGIONAL PATTERNS OF OUTBOUND MOVEMENTS THROUGH THE PORT OF GENOVA, IN PERCENT, 1953 TO 1955[1]

Origination	1953	1954	1955
Lombardia	17.3	20.7	19.1
Piemonte	12.7	13.0	15.1
Liguria	53.0	47.6	49.1
Veneto	2.5	2.2	2.5
Emilia	2.9	4.6	3.5
Toscana	5.9	4.3	3.7
Southern and central Italy	2.3	3.4	2.3
Foreign	3.4	4.2	4.7
Total	100.0	100.0	100.0

[1] Source: Compiled from the records of the C.A.P.

THE HINTERLAND OF THE PORT[10]

In the light of the previous discussion, it is clear that Genova does not serve a "static hinterland." The service area varies with the direction of movement (inbound or outbound), with the commodity considered, and with time. Yet the student of ports cannot avoid the problem of hinterland delimitation, for one of his major objectives should be an analysis of the significance of the hinterland as a traffic generator for the port. Thus a determination of the nature and extent of this service area becomes not merely a cartographic exercise, but a basic step in evaluation of the potential development of a port.

Delimitation of the Hinterland

Weigend has defined the hinterland as "organized and developed land space which is connected to the port by means of transport lines and which receives or ships goods through that port."[11] If transport links alone are considered, a map can be constructed delimiting on a physical base of effective distance the Genovese service area. Figure 19 shows the areas that are closest to each of the major ports of northern Italy by road or rail connections.[12] The rail regions correspond generally with those areas having the lowest freight rates on major commodities to or from the ports indicated. On this basis, the hinterland of Genova extends through parts of Liguria, Lombardia, Emilia, and Piemonte, excluding, however, the key center of Torino. If this region is considered in the light of the data on internal movements discussed above, it obviously does not coincide with the port's functional hinterland. It is apparent that any effective delimitation of the hinterland of Genova must be based on analyses of traffic flow data.

Morgan, in his studies of the hinterland of Hamburg,[13] used inbound traffic statistics to construct a map showing a series of graded hinterland boundaries. Each line enclosed traffic districts at successive levels of tonnage receipts from the port. For example, the innermost boundary enclosed all districts receiving 200,000 tons or more from Hamburg, the next 100,000 tons, etc. The result was a series of "admittedly arbitrary layers of traffic intensity." In dealing with a port like Genova, in which there is such a contrast in tonnage and value between inward and outward shipments, it was felt that it would be more appropriate, for purposes of comparison, to convert the provincial tonnage data into percentages of inbound and outbound movements. Figure 20 shows the resulting patterns with the choropleth intervals chosen at the 27 and one percent levels.[14]

The maps demonstrate the share of various provinces of northern Italy in Genova's inbound and outbound traffic. Although the outbound distribution is somewhat more dispersed, the patterns are remarkably similar. On both maps the province of Genova, itself, is obviously the core area of the hinterland, but the significance of Milano as a major outlier is also evident, particularly on the inbound distribution. However, with a traffic pattern as highly concentrated as that of Genova, the selection of relatively arbitrary tonnage or percentage limits as the *sole* basis for hinterland delimitation is certainly open to question. In part, the limitation results from the utilization of traffic data for a single port for the delimitation of its service area. Research along these lines necessitates, where possible, the analysis of data from all competing ports on a regional base.[15]

Fortunately the Italian government has re-

[10] It should be noted at the outset that there exists an extensive literature on hinterlands and hinterland delimitation. The pioneer American work in this field was that of Edward Ullman in his study, *Mobile: Industrial Seaport and Trade Center*, University of Chicago, Ph.D. dissertation (Chicago, 1943).

[11] Weigend, "Some Elements . . .", *op. cit.*, pages 192–93.

[12] Minor roads have been eliminated in this delimitation procedure.

[13] F. W. Morgan, "Observations on the Study of Hinterlands in Europe," *Preliminary Report of the Commission on Industrial Ports*, International Geographical Congress (Washington, 1952), pp. 24–32. Reprinted in *Tijdschrift voor Economische en Sociale Geografie*, Vol. 42 (December 1951), pp. 366–73.

[14] Separate arrays were made of the inbound and outbound data, and the intervals were selected at points at which there appeared sharp breaks or dips in the data. For an analysis of a similar procedure see John Alexander and George Zahorchak, "Population-Density Maps of the United States: Techniques and Patterns," *Geographical Review*, Vol. 33 (1943), pp. 457–60.

[15] In the study referred to above, Morgan worked along roughly the same lines by showing the limits of those districts or countries receiving or shipping over 50,000 tons to the chief German ports; he called these "basic hinterlands." *Op. cit.*, Figure 8, p. 30.

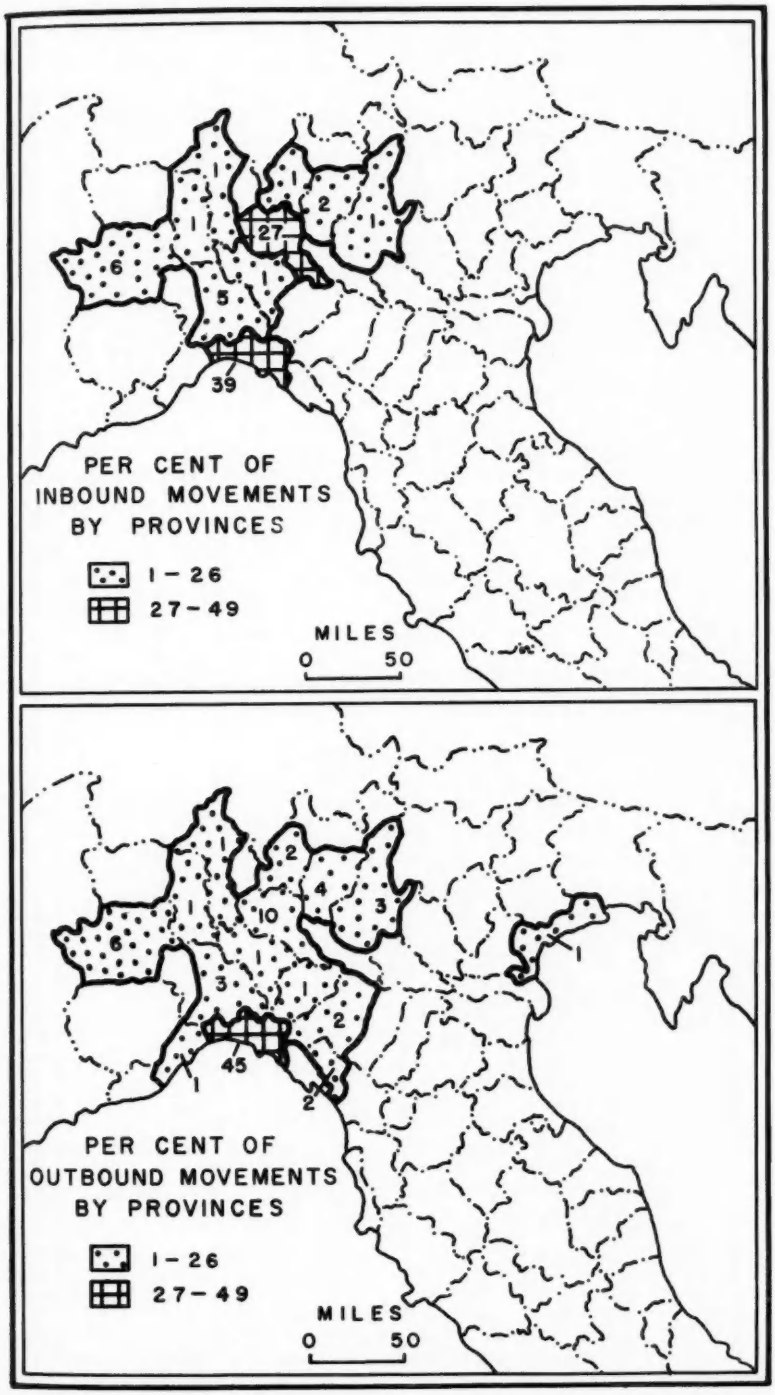

FIG. 20. Provincial Shares of Genova's Inbound and Outbound Traffic in 1954. Compiled from the records of the C.A.P.

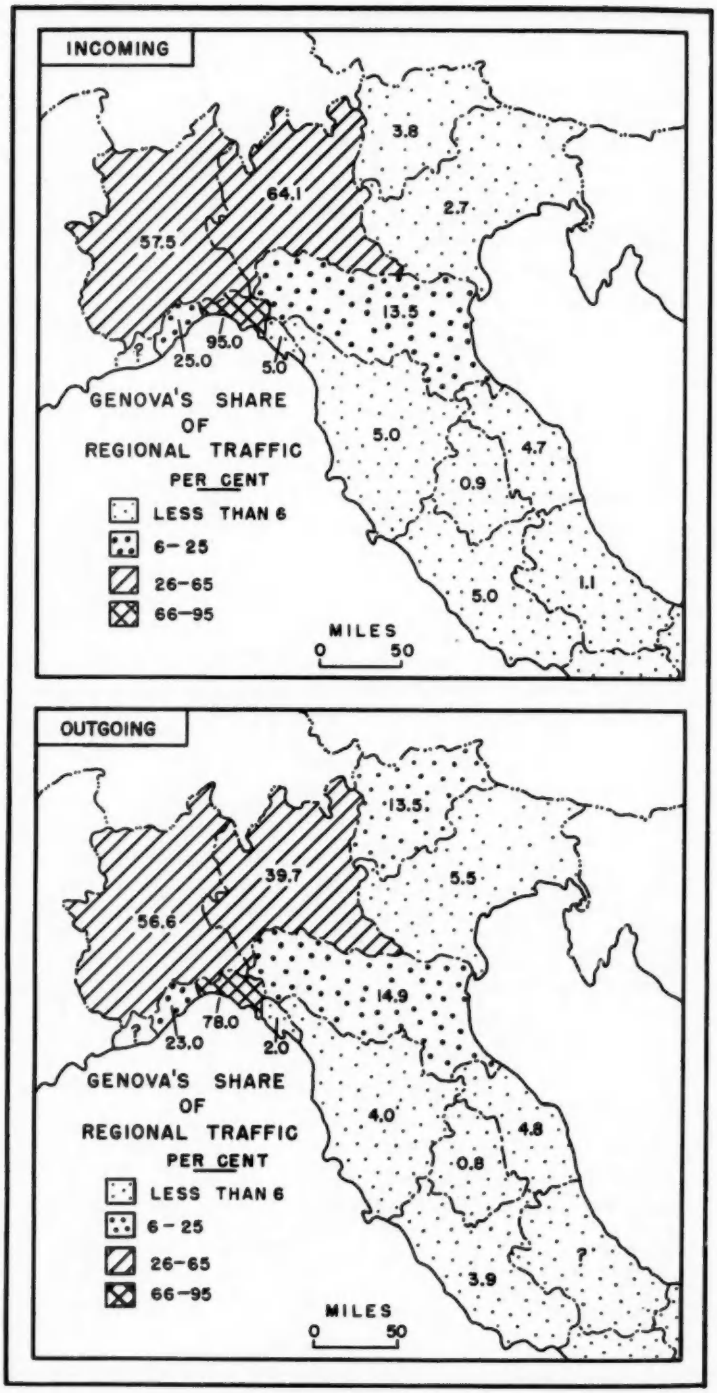

FIG. 21. Genova's Share of Regional Traffic for all Ports, Inbound and Outbound, in 1956. Compiled from data provided by the Sezione Navigazione of the Istituto Centrale di Statistica, Rome, Italy.

cently begun the collection of commodity movement statistics for all Italian ports, and for the purpose of this study these data were compiled to indicate the *relative share of each port in the over-all traffic of the various Italian Regioni.*[16] The result in terms of Genova's share of the inbound and outbound traffic for 1956 is shown in Figure 21. In general these data reflect the same pattern that was observable on the previous maps, but there are significant regional variations.

For example, although Emilia accounts for only two percent of Genova's traffic, the region is a zone of major competition between the ports of Ravenna, Genova, and Venezia. Genova's share of Emilia's traffic is roughly one-seventh of the total, and this proportion increases markedly in Piacenza and Parma, the westernmost provinces. Although Lombardia's inbound traffic is dominated by Genova with approximately two-thirds of the total, in the outbound traffic pattern its share was only two-fifths of the movements, while that of Venezia was over one-third of the total. A study of the traffic data and Figures 20 and 21 indicates that the easternmost provinces, Bergamo and Brescia, are zones of major competition between these two ports with Venezia probably in the ascendancy in the latter. Piemonte's traffic moves mainly through the port of Genova, but even here, Savona accounts for roughly one-third of the total, and it dominates the trade of Cuneo, as well as that of its own province (which is part of Liguria). The province of La Spezia is obviously the primary hinterland of its own port, while Genova is ascendant in its own province, but even here more than a fifth of the outbound traffic moves through Savona.

These data are a major corollary tool in hinterland analysis, for they provide a quantitative indication of the part that a port plays in the regional traffic pattern and of its position with respect to other competing ports. Although detailed provincial statistics are lacking, an estimate can be made of those regions of northern Italy in which the relative share of Genova is over half of the traffic. The resulting pattern is shown on Figure 22.[17]

It is evident from the preceding discussion that the delimitation problem must be approached from two viewpoints. The first of these is *the share of a region in the traffic of a port*, and the second, *the share of the port in the traffic of a region.* Both of these approaches have been used in the delimitation of the "nodal hinterland" of Genova.[18] This region has been defined as including all areas which fit *all* of the following criteria: (1) provinces which absorbed at least one percent of Genova's inbound traffic in 1954; (2) provinces which provided at least one percent of Genova's outbound traffic in 1954 (Fig. 20); (3) provinces in which Genova's share of the region's traffic was estimated to be predominant (fifty percent or more) in 1956 (Fig. 22). The resulting pattern of the "nodal hinterland" of Genova is shown on the lower map of Figure 22.

This method constitutes an exploratory step in the direction of a quantitative delimitation of the hinterland of a port. It should be noted that there are certain shortcomings in this procedure. For example, the selection of a one percent limit on inbound and outbound movements is subject to question; it was significant for Genova, but the same limit might not be critical for another port. Secondly, an objection could be raised to the use of a line bounding these borders rather than a zone of decreasing intensity. Another limitation lies in the use of estimates rather than exact statistics for the share of Genova in the traffic of

[16] These data were secured from the Istituto Centrale di Statistica, Sezione di Navigazione in Rome. Statistics were only available for the Regioni and for the provinces within which the ports are located. The data are now being published on a monthly basis in the *Bollettino Mensile di Statistica*, Rome, Italy.

[17] For a few provinces the delimitation is based on actual traffic statistics for 1956. For the others it is dependent on estimates which are the results of field interviews in 1955 and 1956 with port officials in northern Italy. The estimates have also been checked with those by Pedrini of the hinterlands of La Spezia and Savona in his study *I Porti delle Rivieri Liguri* ("Memorie di Geografia Economica," Vol. 16 [Naples, 1957]), pp. 40–48 and 75–80, and those by Candida of the hinterland of Venezia in his monograph *Il Porto di Venezia* ("Memorie di Geografia Economica," Vol. 3 [Naples, 1950]), pp. 152–208.

[18] The terms "nodal" and "core" are adopted from the work of Whittlesey and his collaborators in P. James and C. Jones, *American Geography: Inventory and Prospect* (Syracuse, 1954) Chapter II, "The Regional Concept and the Regional Method," particularly pp. 37–42. Ullman in a study referred to earlier was the first American geographer to develop the concept of "primary hinterland" and weakened connections with increasing distance from a port: E. Ullman, *Mobile, op. cit.*, p. 65.

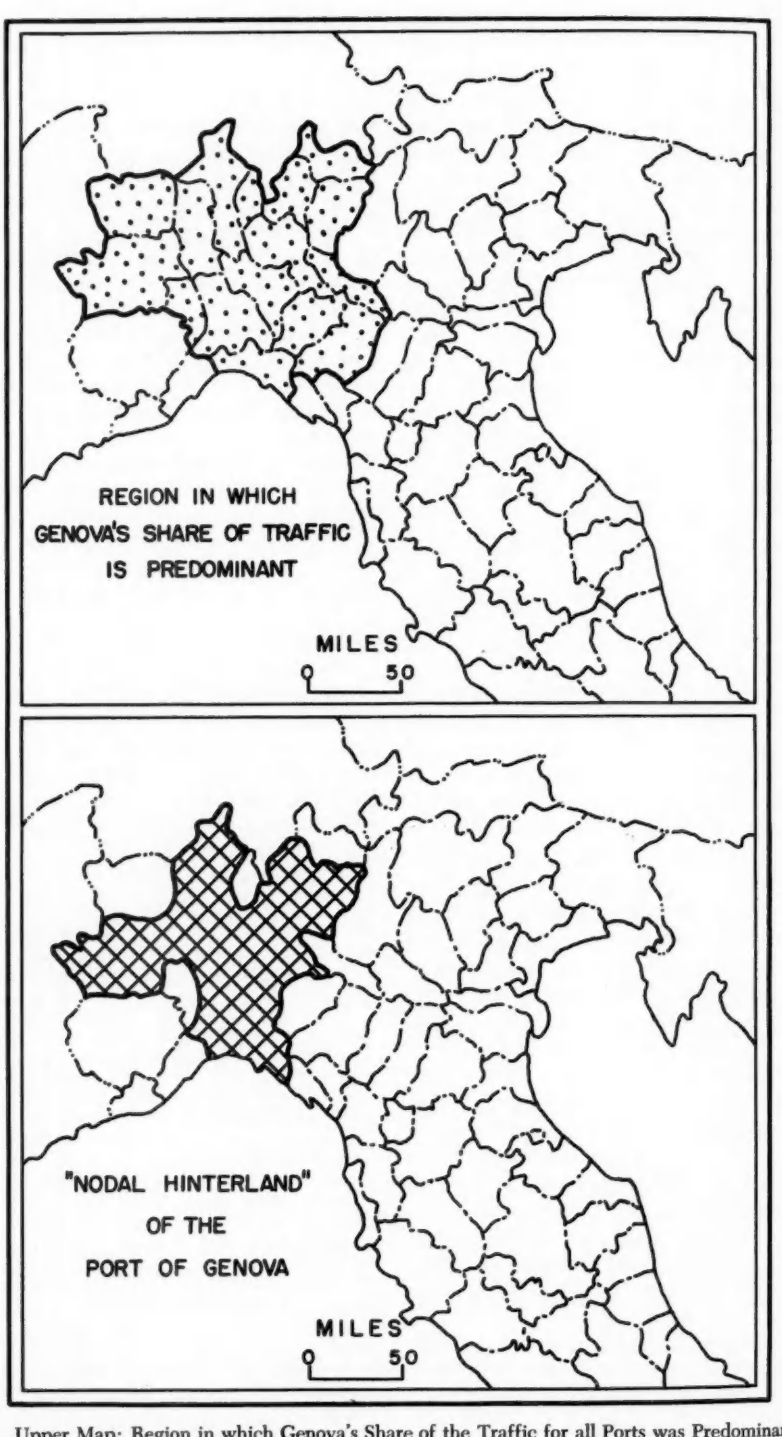

FIG. 22. Upper Map: Region in which Genova's Share of the Traffic for all Ports was Predominant in 1956. Lower Map: Nodal Hinterland of the Port of Genova.

each province. Nevertheless, despite its shortcomings, this method would facilitate the comparison of the "nodal hinterlands" of competitive ports on a uniform basis, and it would permit analyses of the changes in the extent of these hinterlands with the passage of time. Further research towards the quantitative measurement of hinterland limits is certainly in order, and there exists a vast body of port traffic data which could be tapped for this purpose.[19]

Nature and Extent of the Hinterland

Over four-fifths of the traffic of the port of Genova is generated in its "nodal hinterland," and this relationship has remained relatively constant over the past three decades. This region, which provides the basic support for Genova, is undoubtedly the single most important economic area in Italy. Although it comprises only one-eighth of the territory of the country, it contains one-fifth of its population, three of its largest urban centers, and over 44 percent of its manufactural employment. More than any other Italian region, this area depends for its economic sustenance on spatial interchanges with the outside world.

Beyond the margin of the "nodal hinterland," there is a distinct weakening of ties with the port but even central and southern Italy provide a share of Genova's traffic. These areas use the port for movement of high-value manufactured goods in which transport costs are a minor part of the total cost structure. In addition, goods may be received or shipped through Genova because of superior handling facilities (physical and commercial) or because of existing corporate relationships between shipping firms and manufacturing establishments.[20]

Internally, connections are considerably intensified with *decreasing* distance from Genova. It is possible, therefore, to distinguish a "core" within the "nodal hinterland," or that part of the hinterland which is most closely tied to the port. Detailed traffic statistics indicate that the limits of this "core" are roughly coterminus with those of the Genova industrial area. This subregion accounts for over two-fifths of Genova's traffic, and nine-tenths of its traffic moves through this port. The "core" has a population of over 700,000 inhabitants, and it is one of the most important industrial nodes in Italy with over 75,000 employed in manufacturing in 1957. In large measure, the industrial development of this area is dependent on the movement of commodities through the port.

It is also apparent from an inspection of Figures 20 through 22 that there exists a major outlier beyond the "core" hinterland. This tributary region is centered in the Milano industrial area. The province of Milano, within which it is located, accounts for over one-fifth of Genova's traffic, and its overseas ties are also predominantly through this port.

Concerning the nodal hinterland, the question can logically be asked, "To what factors is the extent of this region attributable?" In general the shape, size, and intensity of Genova's hinterland is a reflection of transportation costs between this region and competitive ports, and these costs in Italy are largely a function of distance. It is for this reason that the tributary areas on Figures 19 and 22 are so similar. However, the relationship is not perfect and other factors must be considered.

Another significant element appears to be that of connections between the hinterland and alternate ports; in this instance ease and rapidity of connections play an important role in both road and rail transport. In the competition between Venezia and Genova, particularly for eastern Mediterranean movements, the latter seems to be at some disadvantage because of pressure on its rail facilities by industrial traffic. On the other hand, while Genova's connections with Torino are longer than those for Savona, its traffic moves predominantly through the former port because of the *relative* ease and rapidity of rail connections to Torino. For truck transport, Genova's attraction has been enhanced by its position on a superhighway (by Italian stand-

[19] Excellent work along these lines is evident in two unpublished reports by Patton on the hinterlands of Atlantic and Gulf Coast ports. Donald Patton, *The Hinterland Relations of the Ports of Halifax and Saint John*, Report No. 1 (June 1957), and *General Cargo Hinterlands of New York, Philadelphia, Baltimore and New Orleans*, Report No. 2 (March 1958), ONR Contract 388-033, University of Maryland, College Park, Maryland.

[20] For examples of the significance of such ties in industrial development in the Genova area, see A. Rodgers, "The Role of the State in the Industrial Development of the Port of Genova, Italy," *Proceedings of the Regional Science Association*, Vol. 3 (1957), pp. 290–300.

ards) over the Ligurian Appennines. The same relationship also applies to competition between La Spezia and Genova for markets in Emilia. Government policy has also played a role in the pattern by granting preferential rates to the port of Trieste as well as a number of ports in the Italian South, which may in a limited sense affect the nature and extent of Genova's hinterland. Other factors that might be considered here are: the adequacy of facilities and frequency of services at Genova and competing ports, the role of Italian tariff policies, French railway policy in relation to movements between Marseilles and Switzerland, the impact of Rhine River movements on the direction of Switzerland's overseas flows, etc. The few factors that have been cited here illustrate the complexity of the forces that have moulded and will continue to shape Genova's hinterland.

Significance of Hinterland Analysis in Planning for the Port of Genova

It was stressed earlier that the delimitation of a port's hinterland and an analysis of its nature and extent were basic steps in an evaluation of the prospects for further development in that port. While no attempt will be made here to predict the course of Genova's future as a port, several illustrations can be offered to demonstrate the utility of hinterland analysis in port planning.

The massive shift in the inbound bulk cargo from coal to petroleum since the war has been noted previously; it has not only moulded the volume and direction of traffic flow, but concomitantly it has affected the structure of port facilities which have had to be designed for debarkation, storage, and transmission of petroleum. It is apparent then, that an analysis and forecast of future demand for petroleum in the nodal hinterland should be of vital interest to this port.

In another sector of port activity the construction of the Cornigliano steel mill has been a major factor in the growth of bulk traffic imports in Genova; yet, these movements have had relatively modest effects on the development of facilities, revenue receipts, and labor force requirements in the port. In addition the plant has provided only limited export cargoes for Genova. An analysis of the present raw material requirements of this mill and its market structure, as well as a forecast of its future development and requirements could also prove extremely useful in an evaluation of the future traffic pattern of the port. These are only a few of the examples that could be cited to illustrate the utility of hinterland analysis in port planning, but they indicate some of the lines along which further research in this field might proceed.

GENOVA'S FUNCTION AS A BREAK OF BULK CENTER

The data that have been presented to this point can be considered as the transit phase of the port's operations. These, however, are only a part of the total complex of spatial interchanges between a port and its hinterland. Most ports are not merely transit funnels but break of bulk centers as well.[21] As the media of transport change from water to land carriers, or the reverse, auxiliary services develop, such as storage, sorting, repackaging, etc., with many shipments moving through the hands of commercial agents who sell these products in hinterland markets. In addition the break of bulk center becomes a logical point for the processing of goods, particularly those in which there is a major reduction of weight and bulk in the manufacturing operation. These goods are also destined for markets in the port's hinterland. In the reverse sense, goods may move from the hinterland to the port for processing prior to export. Neither of these two groups of movements will appear in port statistics, for the destination or origin will be indicated simply as the port or the political unit within which it is located. Yet these movements are a significant phase of the relationships between a port and its service area. In the case of Genova, 45 percent of the inbound flows moved to the core hinterland, but a large share of these materials eventually moves on to markets in its hinterland either in processed or unprocessed forms. The problem of the flows of goods to and from the port industries has been the subject of recent investigations in the port of Genova. All of the major industrial firms in this area were interviewed in 1955 and 1956,

[21] E. Ullman in "A Theory of Location of Cities," *American Journal of Sociology*, Vol. 46 (1940–41), pp. 853–64 has discussed the principle of "break of bulk." This discussion is, in part, derived from the article. Break of bulk is of course not restricted to the "port" in the narrow sense; in the case of Genova such operations take place throughout the industrial area.

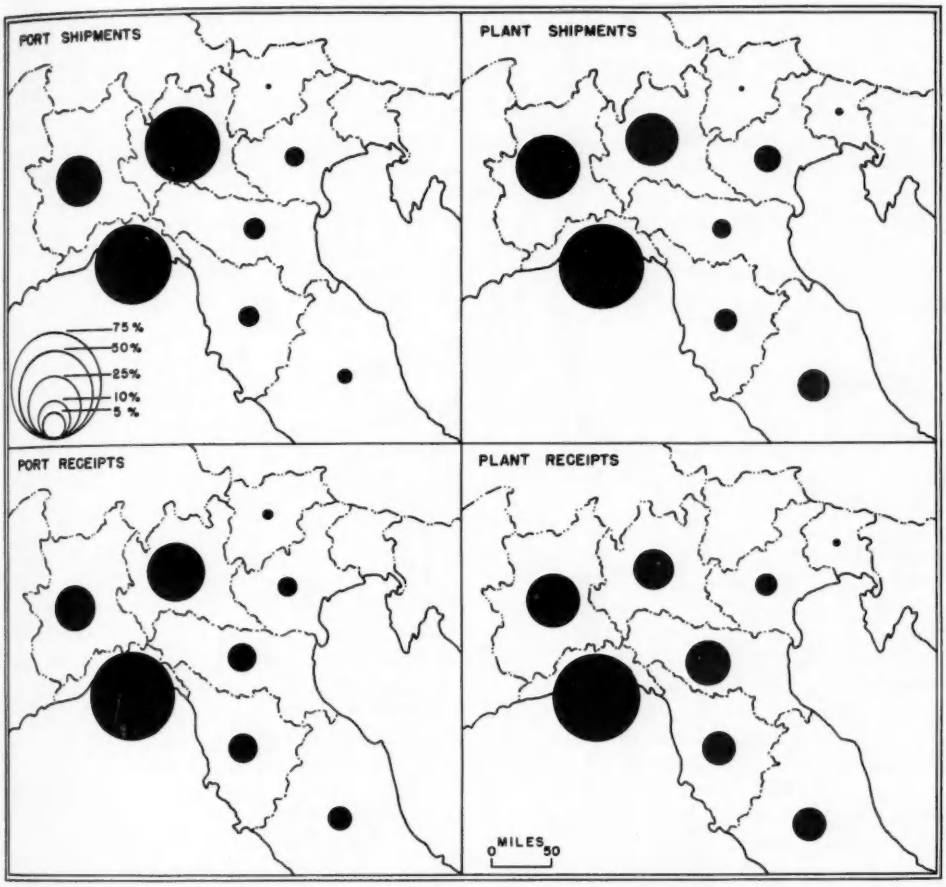

FIG. 23. Comparative Data on Port versus Plant Movements in 1954. Compiled from data secured through plant interviews and from data in *Bolletino Mensile di Statistica* (December 1954), C.A.P., Genova, Italy, various pages.

and data were secured from those establishments in which port movements of materials were of major consequence in the firm's operations. These plants provided data, on a regional basis, for sources of the various raw materials utilized in their operations and markets for each of their products.

The data on movements of materials and finished products for these manufacturing plants are presented in the two right-hand maps in Figure 23. The upper map represents shipments or inbound movements on a percentage base, and the lower indicates receipts or movements outbound from the interior. The adjoining maps on the left indicate the port shipments or receipts also expressed on the same basis. It should be noted that Liguria, or what in essence should be considered the Genova area, stands out on all four maps accounting for 40 to 50 percent of the movements.

A comparison between the transit movements and the plant shipment data indicates important differences in these distribution patterns. No detailed comparison will be attempted here,[22] but the relative shifts in importance of Piemonte and Lombardia are apparent as well as the wider dispersion of the manufactural flow data. A large share of

[22] The detailed comparisons of port and plant flows will be treated in a forthcoming study of the "Industrial Structure of the Port of Genova."

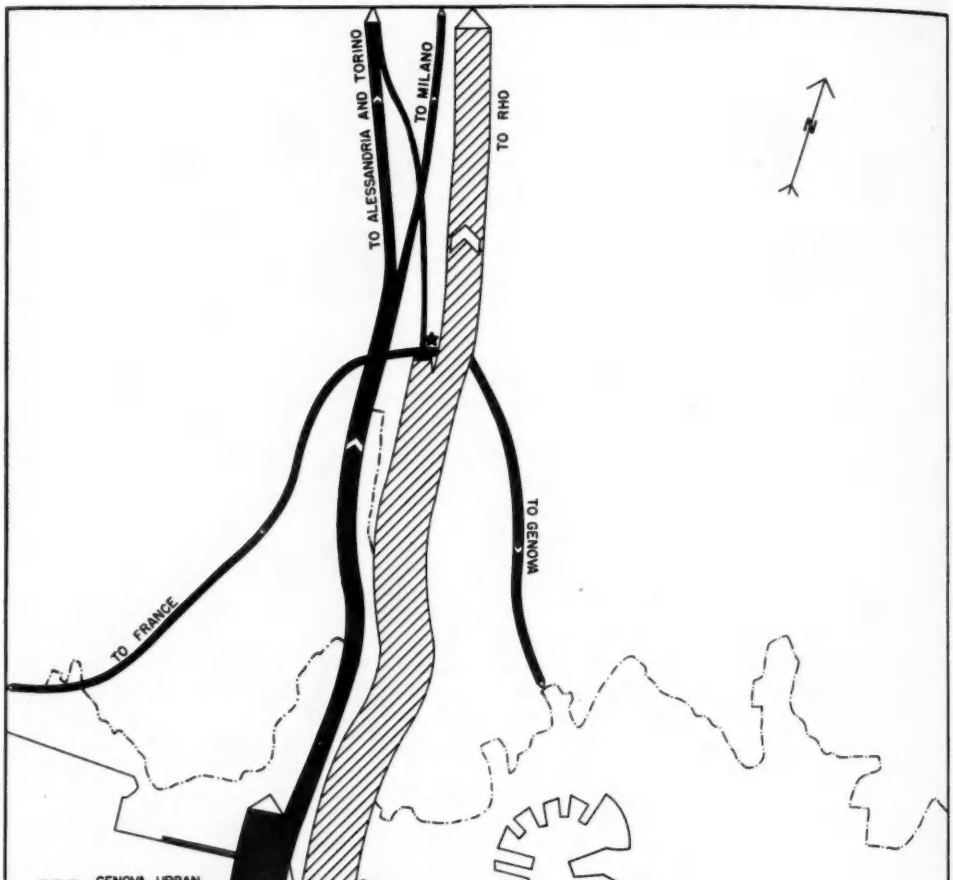

FIG. 24. Petroleum Movements through Genova in 1954 as an Illustration of the Processing Function of the Port. Compiled from data provided by the C.A.P. and refineries in the Genova area.

the port shipments was in two major categories—the fuels and producer goods, destined largely for utilization in the manufacturing complex of northern Italy, particularly in the Milano area and secondarily in the industrial areas of Piemonte. The manufacturing shipments consisted of both producer and consumer goods, with the former moving to the same areas but with Torino holding a predominant position. The consumer goods plant flows reflect the increased significance of central and southern Italy and are more widely dispersed in relation to Italian end markets.

The discussion thus far has been limited to a general description of the regional patterns

of port and plant flows. Because of the complexity of these movements and space limitations, the patterns of several key commodity groups have been analyzed as indicators of the utility of combined study of these phenomena in hinterland analysis.

The most important groups of commodities that move through the port of Genova are crude petroleum and its derivatives. In recent years, these basic fuels accounted for over two-fifths of the inbound movements, and, as indicated earlier, they have experienced a spectacular relative and absolute growth since 1951.

Of the three-and-three-quarter million tons debarked at the port in 1954, roughly half was crude oil and the remainder consisted mainly of fuel oil and gasoline. The flow patterns are illustrated in Figure 24. The distribution of this large volume of petroleum and petroleum products is extremely complex, but it illustrates the necessity for detailed analyses of both port and plant flows.

Over two-fifths of the petroleum that was debarked at the port was destined for Lombardia, and most of that was crude oil moving by pipeline to the refinery complex at Rho, west of Milano. About one-tenth of the traffic was shipped, mainly by truck, to such centers as Alessandria and Torino in Piemonte. This movement was largely gasoline and fuel oil, for there were no refineries in these areas. Finally, the greatest share, roughly one-half of the total, was destined for the Genova area itself. It should be noted that almost two-fifths of this amount went into various storage depots, some of which serve the bunkerage requirements of the port, and others, particularly at Multedo, west of Genova, serving various trucking concerns which eventually move these products north into the Po Valley. The remaining 60 percent of the Genova shipments was funnelled into two channels. About half was used directly for industrial and other requirements in the urbanized area, and the remainder shipped by pipeline to the refineries in the Fegino–Bolzaneto area. Here the most important end product was gasoline, which was marketed as follows: half was consumed locally, one-fourth moved to the Alessandria area, and the remainder was shipped largely to markets in southern France. By 1957 petroleum imports had increased significantly; refinery capacity in the Genova area had quadrupled, but about half of the end products were marketed in France, due in part to the failure of consumption, both locally and in Piemonte, to keep pace with the growth in refinery capacity. The future development of oil traffic through the port is dependent on demand in the hinterland and this in turn is in part contingent on the results of oil drilling currently under way in the Po Valley.

Another important segment of the inbound traffic of the port consists of various raw and semifinished materials destined for metallurgical plants in the Genova industrial area. The most important of these plants is the new steel mill at Cornigliano. Here again a study of the plant flows is of great value in hinterland analysis, for the end products of this mill are largely destined for markets outside of Genova and must be considered as an integral part of the spatial interchanges between the port and its hinterland. Figure 25 shows the flow patterns for this plant.

In 1955 the Cornigliano Works received, via the port, roughly 100,000 tons of scrap, 700,000 tons of iron ore, almost half of a million tons of coking coal, and 50,000 tons of limestone. In all then, over one and a third million tons of materials moved via the port to this mill. In addition, almost half of a million tons of raw materials and scrap moved to the plant by rail and truck. The map shows the distribution of the steel products produced by Cornigliano of which almost half went to the Fiat works at Torino and a quarter to the Milano area. Only a small fraction of the output remained in the Genova area. This is a comparatively new development, for prior to 1952 there was no integrated steel mill in this region, so that the inbound movements through the port at that time would have contrasted sharply with the present pattern. In addition, the growth of this plant is largely dependent on the Fiat market for sheets and strips. If this company should go ahead with the construction of a new steel mill at Savona, which seems unlikely at the present moment, then the volume of material receipts and the direction of finished product movements could change drastically.

The significance of manufactural flow data in hinterland analysis can also be seen in many other industries in Genova, such as the processing of hides by the tanning industry

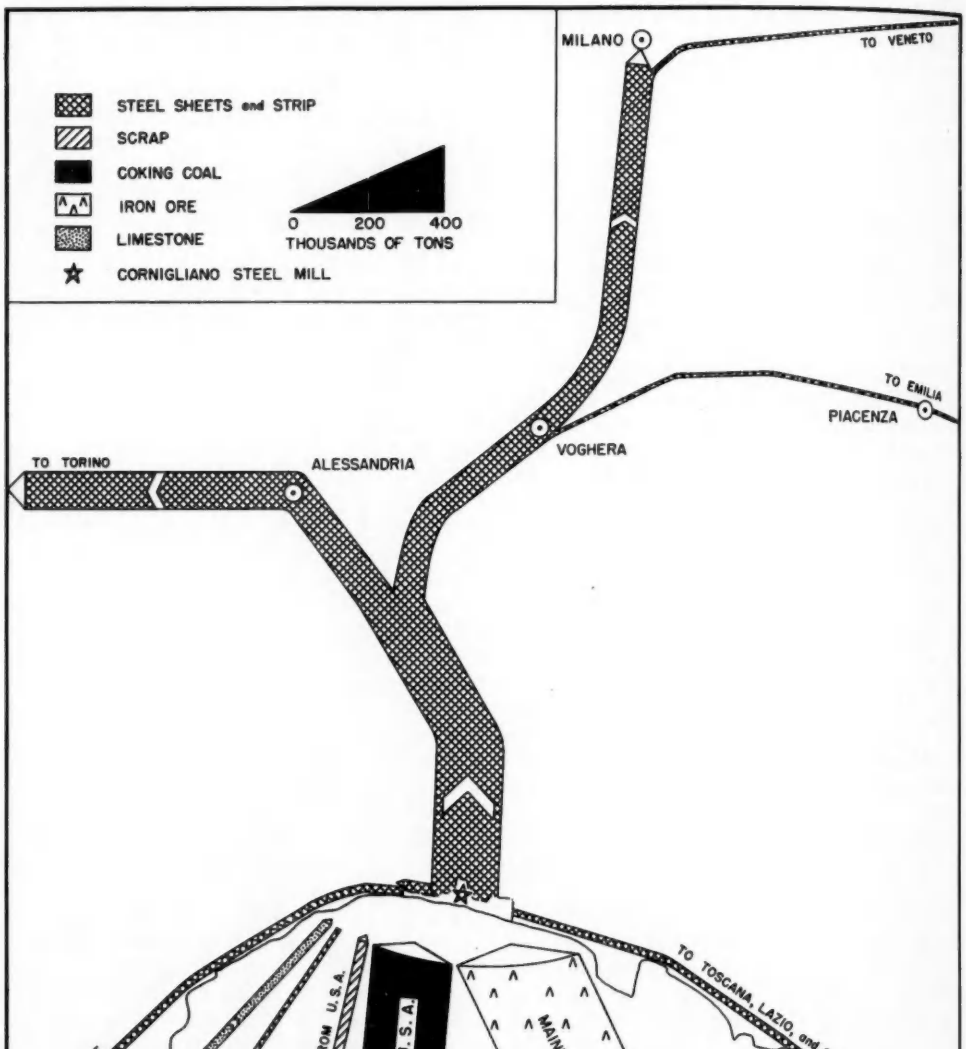

FIG. 25. Raw Material Receipts and Finished Steel Shipments for the Cornigliano Steel Mill as an Illustration of the Processing Function of the Port. Compiled from data provided by the Cornigliano steel mill (Cornigliano S.p.a.).

FIG. 26. Provincial Divisions and Provincial Centers in Northern Italy, 1958.

for markets in Toscana, wool cleaning and scouring for eventual shipment to Piemonte, the soap industry, and many others.

No attempt has been made in this study to trace the commercial aspect of the port's function as a break of bulk center. This phase is also critical in understanding the relations of a port and its hinterland. Work along this line in port studies would prove extremely fruitful and should be the object of further research.

In conclusion this study of Genova has emphasized what the author believes are critical aspects of port geography, namely, the external and internal relations of a port. An attempt has been made through the use of traffic statistics to measure these spatial interchanges not only in their present context but over time as well. Our investigations of the port of Genova, which are only partially reported here, have shown that it is far more than a strategically located funnel through which goods move in and out of the Po Valley. It is also a major break of bulk center, and the relationships between this port and its hinterland cannot be explained without a consideration of this key function.

RAILROAD TRAFFIC DENSITIES AND PATTERNS

WILLIAM H. WALLACE
The University of New Hampshire

THROUGH the nature of their traffic, transportation media reveal a great deal of the geography of the areas which they serve. The variations of traffic from place to place reflect areal differences in populations, settlements, and economic activities, and the flow of traffic measures the movements of people and goods between regions. This is particularly true of traffic on railroads, which, in most intensively developed parts of the world, are still the dominant means of internal[1] freight transportation.

The purpose of this paper is to examine two aspects of railroad traffic that have considerable significance to geography: the general level of traffic density on railroads and, secondly, the pattern of rail traffic movements as revealed by local variations in density and directions of flow.

THE INTENSITY OF RAILROAD ACTIVITY AS MEASURED BY TRAFFIC DENSITIES

The level of traffic density is a measure of the intensity of activity on a rail system. Because of the general importance of railroads as transportation agents, it also provides a useful indication of the tempo of human activities in the areas served by the railway. In this section of the paper, the levels of traffic density on the railways of the world will be compared,[2] attempts will be made to arrive at an understanding of the causes of the differences that exist, and, finally, a number of generalizations will be formulated about the factors affecting the intensity of rail activity.

Available statistics permit assessment of traffic densities within most of the countries of the world as well as within regions or on individual railroads in the United States, New Zealand, and Australia. Rail traffic data are usually compiled separately for passenger traffic (passenger-kilometers or passenger-miles) and freight traffic (ton-kilometers or ton-miles), and this situation, together with the fundamentally different character of these two types of rail activity, makes necessary separate consideration of freight and passenger traffic. The intensity of rail activity may best be determined by relating the amount of transportation service rendered to the length (extent) of the railnet. For passenger traffic, this gives traffic densities in terms of passenger-miles per route-mile of line; for freight traffic, density is expressed in terms of ton-miles per route-mile of line.[3] On these bases, there are striking differences in the intensity of activity on the railroads of the world.

Freight Traffic Densities on the Railroads of the World

In recent years[4] freight traffic densities have been far heavier on the railnet of the Soviet Union than on the railroads of any other country (see Tables 1 and 2 and Fig. 1). In 1954, Soviet traffic density was approximately three times that for the American railroads as a whole.[5] Freight traffic intensity on the Chinese railroads was also considerably greater than the average for the entire United States railnet, and densities in Czechoslovakia almost equalled the American national level.

[1] The term "internal" is used to describe movements within a continuous rail, road, or waterway network—either that of a single country (Chile, Australia, Ireland, Japan) or a continent (North America, Europe); in contrast are "external" movements that flow through exporting or importing ports and connect continents or widely separated countries.

[2] That is, on those railways that reported 1954 data to the Statistical Office of the United Nations Department of Economic and Social Affairs. The major countries that did not report rail traffic statistics to the U.N. in 1954 were the Soviet Union, China, and the countries of Eastern Europe. Soviet data were obtained from other sources. 1954 statistics for all of the Communist-bloc countries and a handful of other states became available after the maps accompanying this paper were prepared and these appear in Table 2. Chinese data used for the maps accompanying this paper are for 1948.

[3] In this analysis, freight traffic densities are measured in terms of net metric ton-miles per route-mile of line because this type of data is more widely available than any other concerning freight traffic.

[4] Data used in this study are for 1954, or the latest previous year for which data are available.

[5] Freight traffic density on the entire U.S. railnet during the year 1954 was 2,223,262 net metric ton-miles per route mile of line. This was exceeded by the all-time record density of 2,806,617 during the war year of 1944. American data for years prior to 1954 are from *Statistical Abstract of the United States—1946*, p. 508.

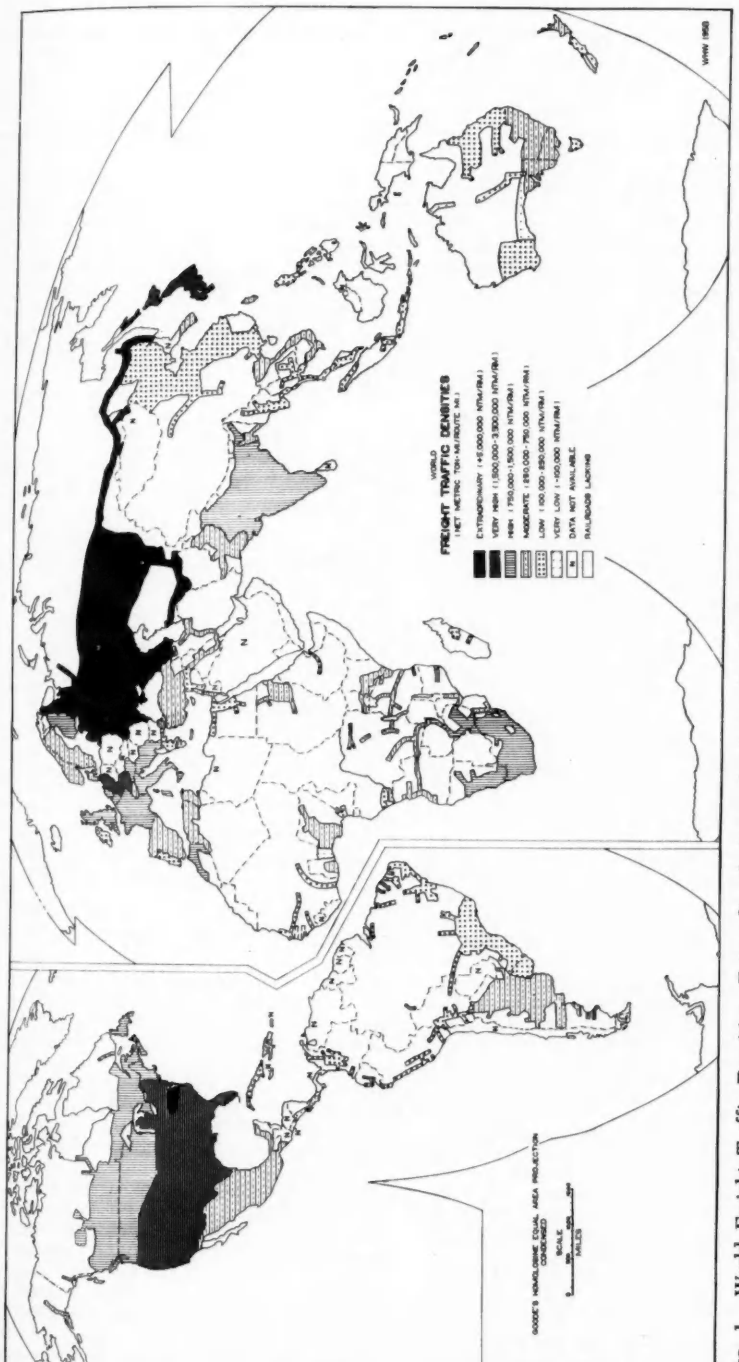

FIG. 1. World Freight Traffic Densities. Extraordinarily heavy freight traffic densities occur on the railroads of the Soviet Union; the only large group of American railroads on which densities approximate the Soviet level are those of the Pocahontas Region. Very high intensities prevail in most parts of the United States and in West Germany and Japan. Densities in southern Africa and India are comparable with those in northern Anglo-America and most of "industrial" Europe. On the railroads of nonindustrial countries low densities are the rule.

TABLE 1.—WORLD RAILROAD TRAFFIC DENSITIES[1]

Rail system	Date	Passenger traffic density (passenger-mi./route mi.)	Freight traffic density (net metric ton-mi./route mi.)
North America			
Alaska (Alaska RR only)[2]	1954	39,000	482,000
Canada	1954	67,000	1,228,000
United States (all RR)[3]	1954	130,000	2,223,000
New England Region	1954	380,000	1,259,000
Great Lakes Region	1954	200,000	2,906,000
Central Eastern Region	1954	300,000	3,377,000
Pocahontas Region	1954	73,000	5,118,000
Southern Region	1954	98,000	2,018,000
Southwestern Region	1954	50,000	1,718,000
Central Western Region	1954	128,000	2,211,000
Northwestern Region	1954	61,000	1,386,000
Cuba	1954	67,000	205,000
Mexico	1954	136,000	427,000
Costa Rica	1953	64,000	70,000
Nicaragua	1954	269,000	76,000
South America			
Colombia	1954	196,000	191,000
Ecuador	1954	93,000	113,000
Peru	1953	75,000	136,000
Bolivia	1952	88,000	117,000
Brazil	1953	300,000	238,000
Uruguay	1948–49	115,000	141,000
Argentina	1954	321,000	361,000
Chile	1954	207,000	n.a.
Europe			
Ireland (incl. Eire and Northern Ireland)[4]	1954	n.a.	109,000
Great Britain[4]	1954	1,088,000	1,179,000
Portugal[4]	1954	454,000	190,000
Spain (State Rwys)[4]	1954	600,000	585,000
Italy (State Rwys)[4]	1954	1,321,000	785,000
Yugoslavia[4]	1954	558,000	824,000
Greece[4]	1954	326,000	145,000
Turkey[4]	1954	506,000	494,000
France (State Rwys)[4]	1954	668,000	1,044,000
Belgium (State Rwys)[4]	1954	1,538,000	1,146,000
Luxembourg[4]	1954	520,000	1,065,000
Netherlands[4]	1954	2,214,000	1,058,000
West Germany[4]	1954	1,088,000	1,705,000
Switzerland	1954	1,347,000	520,000
Austria (State Rwys)[4]	1954	862,000	1,008,000
Denmark[4]	1954	710,000	268,000
Sweden[4]	1954	407,000	613,000
Norway[4]	1954	351,000	324,000
Finland[4]	1954	428,000	849,000
U.S.S.R.[5]	1954	n.a.	6,652,000
Africa			
Union of South Africa	1954	n.a.	1,087,000
Rhodesia (N. & S.)	1954	n.a.	1,301,000
Mozambique	1954	55,000	502,000
Madagascar	1954	146,000	147,000
Angola	1953	37,000	253,000
Belgian Congo	1954	52,000	481,000
British East Africa	1954	n.a.	489,000
Cameroons (French)	1954	177,000	200,000
French Togoland	1954	156,000	30,000
French Eq. Africa	1954	78,000	184,000
Gold Coast	1954	261,000	298,000
Nigeria	1954	185,000	579,000
French West Africa	1954	138,000	127,000
Sudan	1954	n.a.	324,000
Ethiopia and French Somaliland	1954	n.a.	161,000
Reunion	1954	133,000	56,000
Morocco	1954	342,000	912,000
Algeria	1954	179,000	306,000
Tunisia	1954	123,000	414,000
Egypt	1954	423,000	189,000
Asia			
Israel	1954	562,000	348,000
Syria	1954	50,000	146,000
Lebanon	1954	10,000	55,000
Iraq	1953	309,000	504,000
Iran	1954	185,000	534,000
Pakistan	1954	805,000	473,000
India	1953	1,139,000	909,000
Burma	1954	244,000	184,000
Malaya	1954	n.a.	230,000
Indonesia	1954	639,000	155,000
Thailand	1954	705,000	204,000
Philippines (Manila RR only)	1954	443,000	152,000
Viet Nam	1953	168,000	258,000
China	1948	607,000	207,000
Hong Kong	1954	2,056,000	112,000
Taiwan	1954	553,000	364,000
South Korea	1954	1,483,000	715,000
Japan (State Rwys)	1954	4,341,000	1,961,000

[1] Traffic densities are approximate, to the nearest thousand passenger-miles or ton-miles. Unless otherwise specified, traffic data are for the entire rail system of the country indicated. Passenger traffic data *do not* include traffic on urban subway, elevated or surface transport systems, but they do include suburban traffic on "line haul" railroads. The notation "n.a." indicates that data are not available. Unless otherwise indicated, traffic data are from *Statistical Yearbook 1955*, Statistical Office, United Nations Dept. of Economic and Social Affairs (New York, 1955). Mileage data were taken from S. H. Steinberg (ed.), *Statesman's Yearbook 1956* (London: Macmillan, 1956), unless otherwise noted.

[2] Alaskan data are from *Statistical Abstract of the United States 1956*, Washington, D.C., Bureau of the Census, U. S. Dept. of Commerce (1956), p. 569.

[3] American data are from *68th Annual Report on Transportation Statistics in the United States for the Year Ended 31 December, 1954*, Washington, Interstate Commerce Commission (1955).

[4] Mileage data from *Annual Bulletin of Transport Statistics for Europe 1954*, Geneva, United Nations, 1955, Table C, pp. 64–5.

[5] Soviet traffic data are from *Bulletin of the Institute for the Study of the USSR*, Vol. IV, No. 3 (March 1957), p. 44.

TABLE 1.—*Continued*

Rail system	Date	Passenger traffic density (passenger-mi./route mi.)	Freight traffic density (net metric ton-mi./route mi.)
Australia (all rwys)[6]	1953	n.a.	250,000
New South Wales Rwys[6]	1953	n.a.	467,000
Victorian Rwys[6]	1953	386,000	275,000
Queensland Rwys[6]	1953	n.a.	200,000
South Australian Rwys[6]	1953	108,000	266,000
Western Australian Rwys[6]	1953	27,000	102,000
Tasmanian Rwys[6]	1953	59,000	139,000
Commonwealth Rwys (all)[6]	1953	29,000	60,000
Trans-Australian Rwy[7]	1953	51,000	45,000
Central Australia Rwy[7]	1953	8,000	123,000
North Australia Rwy[7]	1953	1,000	5,000
Aust. Capital Terr. Rwy[7]	1953	79,000	63,000
New Zealand (all rwys)	1954	n.a.	325,000
North Island rwys[7]	1954	n.a.	451,000
South Island rwys[7]	1954	n.a.	221,000

[6] Data for Australian rail systems are from *Yearbook of the Commonwealth of Australia, 1955*, Commonwealth Bureau of Census and Statistics, Canberra (1956), pp. 234–35.

[7] Estimated density, based on level of traffic reported in annual report of railway system for earlier years.

Within the United States traffic is far heavier in the Pocahontas Region[6] than elsewhere, and only on a handful of coal-hauling roads and a few iron ore carriers that function as part of the Great Lakes transportation system do freight densities approach those on the Soviet railnet. Freight traffic on the railroads serving the heart of the American Manufacturing Belt[7] is approximately two-thirds as intense as on the Pocahontas roads and does not equal the densities on the railroads of China. The railroads of Japan, Poland, and West Germany carry a traffic which, though lighter than the average for all American lines, is still very heavy by comparison with intensity elsewhere in the world.

The density of freight traffic is relatively heavy in the industrial, mineral-producing countries of Europe, and also on the railways of Canada. Traffic is surprisingly heavy in the Rhodesias, the Union of South Africa, and in Morocco, where mining is an important feature of the economies, and the railways are oriented to this traffic. In the United

[6] The Interstate Commerce Commission has grouped American railroads into eight regions:

New England Region — composed of railroads operating in the area east of New York, Albany, and Montreal. Principal roads are the New Haven; Boston and Maine; Maine Central; Bangor and Aroostook; Central Vermont; Rutland; Grand Trunk; and Canadian Pacific Lines in New England.

Great Lakes Region—consisting of railroads operating within the area defined by New York, Albany, Montreal, the Canadian border, the Straits of Mackinac, and Chicago. Principal roads are the New York Central; Erie; Delaware and Hudson; Lehigh Valley; Lackawanna; Nickel Plate; Wabash; and Grand Trunk Western.

Central Eastern Region — consisting of railroads operating within the area defined by New York, Washington, St. Louis, and Chicago. Principal roads are the Pennsylvania; Baltimore and Ohio; Reading; Central R.R. of New Jersey; Pennsylvania–Reading Seashore Lines; Long Island; Western Maryland; Bessemer and Lake Erie; Monon; and Chicago and Eastern Illinois.

Pocahontas Region—composed of railroads operating within the area between Washington, the Hampton Roads ports, Cincinnati, Toledo, and Columbus, Ohio. Principal roads are the Chesapeake and Ohio; Norfolk and Western; Virginian; and Richmond, Fredericksburg and Potomac.

Southern Region—composed of railroads operating within the area defined by the Hampton Roads ports, the Atlantic and Gulf coasts, New Orleans, St. Louis, Chicago, and Cincinnati. Principal roads are the Southern; Atlantic Coast Line; Seaboard; Florida East Coast; Louisville and Nashville; Nashville, Chattanooga and St. Louis; Central of Georgia; Illinois Central; and Gulf, Mobile and Ohio.

Southwestern Region—composed of railroads operating within the area defined by St. Louis, New Orleans, the Gulf Coast, the Mexican Border, El Paso, and Kansas City. Principal roads are the Frisco; Missouri Pacific; Kansas City Southern; St. Louis–Southwestern; Texas and Pacific; Missouri–Kansas–Texas; and Texas and New Orleans (Southern Pacific).

Central Western Region—composed of railroads operating within the area defined by Chicago, St. Louis, Kansas City, El Paso, the Mexican Border, the Pacific Coast, Portland, Spokane, Butte, and Omaha. Principal roads are the Santa Fe; Rock Island; Burlington; Union Pacific; Rio Grande; Southern Pacific; and Western Pacific.

Northwestern Region—composed of railroads operating within the area defined by Chicago, Omaha, Butte, Spokane, Portland, the Pacific Coast, the Canadian boundary, and the Straits of Mackinac. Principal roads are the Great Northern; Northern Pacific; Spokane, Portland and Seattle; Milwaukee Road; Chicago and North Western; Soo Line; Duluth, Missabe Iron Range; Duluth, South Shore, and Atlantic; Chicago Great Western; and Minneapolis and St. Louis.

[7] The railroads serving the heart of the American Manufacturing Belt are those of the Great Lakes and Central Eastern Regions. See footnote 6, above.

TABLE 2.—WORLD RAILROAD TRAFFIC DENSITIES—SUPPLEMENT[1]

Rail system	Date	Passenger traffic density (passenger-mi./route mi.)	Freight traffic density (net metric ton-mi./route mi.)
North America			
Guatemala	1954	n.a.	212,000
Jamaica	1954	131,000	90,000
Trinidad and Tobago	1954	n.a.	71,000
South America			
British Guiana	1954	305,000	11,000
Paraguay	1954	49,000	22,000
Europe			
Bulgaria	1954	590,000	894,000
Czechoslovakia	1954	n.a.	2,149,000
Hungary	1954	906,000	715,000
Poland	1954	1,321,000	1,777,000
Romania	1954	1,018,000	1,150,000
Africa			
Libya	1954	25,000	4,000
Sierra Leone	1954	98,000	52,000
Asia			
Cambodia	1954	127,000	166,000
Ceylon	1954	965,000	181,000
China	1954	n.a.	3,617,000

[1] Traffic densities are approximate, to the nearest thousand passenger-miles or ton-miles. Traffic data are for the entire rail system of the country indicated. Passenger traffic data *do not* include traffic on urban subway, elevated or surface transport systems, but they do include suburban traffic on "line haul" railroads. The notation "n.a." indicates that data are not available. Traffic data are from *Statistical Yearbook 1957*, Statistical Office, United Nations Dept. of Economic and Social Affairs (New York, 1957). Mileage data were taken from S. H. Steinberg (ed.), *Statesman's Yearbook 1956* (London: Macmillan, 1956).

States, freight densities light enough to be comparable to those in Northwest Europe and Southern Africa are found only on the railroads of the Northwestern and New England regions.

Moderate traffic densities are characteristic of a much larger number of national railnets. Freight traffic of intermediate intensity occurs on the railways of countries situated on the peripheries of "industrial" Europe: in Scandinavia, in Spain, and in Algeria and Tunisia. Elsewhere in Africa, moderate freight traffic densities are found in a considerable number of countries where commercial agriculture or mineral extraction are significant activities. Freight traffic of moderate intensity is also prevalent in a group of Asian countries stretching from Turkey eastward to Pakistan, and also including Viet Nam, Taiwan, and South Korea. The national railnets of three southern hemisphere countries with advanced technology and economies based on highly-developed commercial agricultural production—Argentina, Australia, and New Zealand—also carry freight traffic of moderate density. Within Australia and New Zealand, traffic is heaviest in the comparatively densely-populated and productive areas of New South Wales, Victoria, South Australia, and the North Island of New Zealand.

Low freight traffic densities are the rule throughout Latin America, from Cuba to Uruguay, and in many parts of Africa that lack large-scale extractive activities or significant commercial agricultural production. Most of the railways of southeast Asia also handle a light freight traffic. Traffic densities are surprisingly low on the fringes of Europe in the relatively isolated, nonindustrial countries—Eire, Portugal, and Greece. In Australia and New Zealand, low traffic densities are characteristic of the railways of Tasmania, Western Australia, Queensland, on the Commonwealth lines in northern and central Australia, and on the railnet of the South Island of New Zealand.

The factors that determine the levels of railroad freight traffic density are numerous and complexly interrelated. In addition, these factors probably act in unique combinations to produce the densities that are characteristic of each railnet or railroad system. Nevertheless, it is possible to recognize a number of causal factors affecting freight traffic densities that appear to have widespread significance:

1. The presence or absence of significant extraction activity, particularly coal and iron mining. As we have seen, the American railroads with the heaviest traffic are almost all major carriers of coal or iron ore, or both.
2. The presence or absence of significant large-scale, heavy industrial activity, particularly the manufacture of iron and steel. Thus, the railroads of southern New England, serving a manufacturing complex made up primarily of light industries, carry a far lighter freight traffic than the roads of the Great Lakes and Central East-

ern Regions, along whose lines are situated the major American concentrations of heavy industry.

3. The presence or absence of large population concentrations with their vast production and consumption of a great variety of goods.
4. The general level of technology in a country or region, and the standards of living; hence the rates of consumption by the population.
5. The types of agricultural activity within the zone served by the railways—the intensity of farming, the presence or absence of surplus production for shipment to distant markets, and the nature of products. For example, in New Zealand there are strong contrasts between the meager agricultural traffic on railways serving the extensively grazed wool sheep areas of the South Island High Country and movements over lines serving the crop and livestock farming district of the Canterbury Plains or the dairy and mutton sheep farms of the North Island.
6. The pattern of the railnet in a country:
   a) The presence of a large number of light-traffic branch lines will lower the average traffic density of a system and will tend to obscure even very high-density main-line traffic. Thus, in areas of comparable economic activity, railways with complex, intricate patterns tend to have lower traffic densities than rudimentary systems composed largely or entirely of main lines. In this sense, the rail patterns of the U.S.A. and the U.S.S.R. are in strong contrast, and this is perhaps a significant factor accounting, in part, for the higher Soviet traffic densities.
   b) The presence of alternative, competing rail routes between points will also tend to lower the average traffic density on all lines. Thus, in the Soviet Union, there is but one through railway between Moscow and Leningrad; in the United States there are at least seven competing through freight routes linking Chicago with New York.
7. The degree of inter-carrier competition in a country: rail–road, rail–water, and rail–pipeline. In insular or peninsular areas, such as western Europe and the Japanese islands, where many of the major centers of economic activity are coastal, the effectiveness of water competition is increased, as it is where economic activity is concentrated along the valleys of navigable rivers.

Passenger Traffic Densities on the Railroads of the World

A world survey of passenger traffic densities reveals contrasts fully as striking as those that exist in freight traffic intensities. In 1954, densities on national railnets ranged from the phenomenally high level of 4,341,000 passenger-miles per route-mile in Japan to a low of 4,000 passenger-miles per route-mile in Libya (see Tables 1 and 2 and Fig. 2).

High passenger traffic densities are restricted to two major areas—Oriental Asia[8] and Europe. The extraordinary intensity on the railways of Japan is striking, being nearly twice as great as on the lines of the nearest rival (the Netherlands railroads), and more than thirty times as high as in the United States, but densities are generally high on the railnets of these two populous parts of the world. Moderate intensity is characteristic on the railnets of a large number of nations scattered over the world. On the margins of Europe in Scandinavia and on the shores of the Mediterranean, passenger traffic densities are moderate, as they are in the Middle East and in parts of Southeast Asia. In the western hemisphere, moderate densities occur in Argentina, Brazil, British Guiana, and Nicaragua but are lacking elsewhere, if consideration is limited to national railnets. Within the United States, only on the railroads of the densely populated New England and Central Eastern regions,[9] where commutation bulks large, does passenger traffic density reach even moderate levels. In Australia, only the state railway system of Victoria, which also

[8] Oriental Asia is here defined as the arc of countries extending from Pakistan through Indonesia to Japan.

[9] For definitions of these regions see footnote 6. Most of the passenger traffic of the Central Eastern region moves within the Long Island–New York–Washington zone, and it is this traffic that gives the region as a whole its comparatively high density, at least by American standards. Within the New England region, most of the passenger traffic is concentrated in the southern portion.

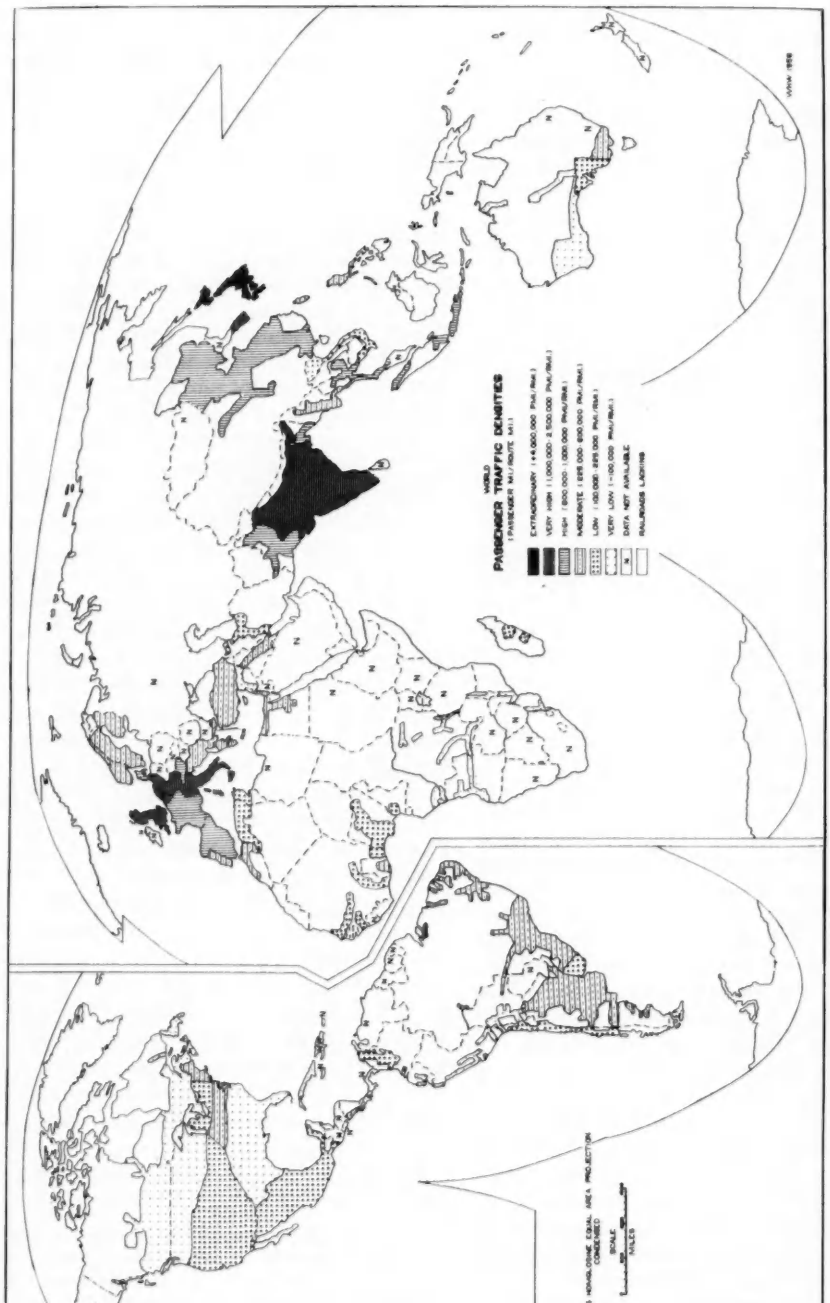

FIG. 2. World Passenger Traffic Densities. Densities on the Japanese railways far exceed those of any other national railnet. High passenger traffic intensities are restricted to Oriental Asia and Western Europe. Within the United States, densities reach moderate levels only in the New England and Central Eastern regions. Low intensities are characteristic of the railroads of most western hemisphere countries and in much of Africa and Australia.

has heavy commuter movements, has traffic of this intensity.[10]

The railnets of most western hemisphere and African countries as well as those of most Australian states have low passenger traffic densities. In the United States, where little more than half[11] of the rail route mileage carries passenger trains, the average for the entire railnet is 130,000 passenger-miles per route-mile. This figure is comparable with those on the railroads of French West Africa, Mexico, Tunisia, and Uruguay. Traffic density on the Canadian railways is about half as heavy as that on the U. S. railnet. Within the United States, the intensity of passenger traffic is lowest in the South, the Southwest, and the Northwest. Comparable or even lower densities prevail in most of Australia.

Like freight traffic densities, the intensity of passenger traffic on the railways of the world is determined by many causes, or combinations of causes, and it is probable that in no two areas do these factors operate in precisely the same manner. However, certain causal factors seem to have widespread applicability, and the list that follows may form the basis for a system of explanation. The factors that determine the density of railroad passenger traffic are:

1. The population density of the areas served.
2. The distribution of population relative to railroads—the accessibility of rail service.
3. The level of technology. In urban and industrial countries, travel of all sorts, including journeys to and from work, is much more common than in lands of rural–agricultural civilization. Commutation appears to be an important factor in high passenger traffic densities.
4. The income levels and standards of living of the population. The availability of surplus funds for travel and, most importantly, the extent of private automobile ownership in a country or region are factors of vital importance to rail passenger traffic. In those areas where automobiles are widely used, rail passenger traffic has suffered accordingly. For example, in the United States private autos now produce approximately 90 percent of all intercity passenger-miles.
5. The pattern of operations on the railroad system—the presence or absence of freight-only lines, or light traffic lines; the presence or absence of alternative or competing rail passenger routes between points. As has been noted, barely half of the U.S. railnet now carries passenger trains. Between most major American cities there are competitive services: for example, four between New York and Chicago, three between Chicago and Minneapolis-St. Paul, three between Chicago and St. Louis.
6. The competitive situation of railroads with respect to other public carriers. Thus, in the U.S.A., air and bus fares are much lower relative to rail fares than in most other parts of the world.

THE PATTERN OF RAILROAD TRAFFIC MOVEMENTS

The pattern of rail traffic movements, as revealed by local variations in density and in direction of flow, provides one of the most valuable means of understanding railroad activity. Until recently, data that permitted analyses of this sort have rarely been available. Within the past few years, however, traffic density maps of railroads in a number of different parts of the world have been released, and these maps make possible a much more complete assessment of rail traffic patterns and their geographic significance than has previously been undertaken.[12]

[10] Data are not available for the state railway systems of New South Wales and Queensland, and hence not for the country as a whole. It is likely that passenger traffic density on the railways of New South Wales would at least equal that on the Victorian system. Data are also lacking for the railways of New Zealand.

[11] In 1954, 55.41 percent of the U. S. route miles or 124,572 miles out of a total of 224,816, carried passenger trains. See *68th Annual Report on Transportation Statistics in the United States for the Year ended 31 December, 1954*, Interstate Commerce Commission, Washington, 1955.

[12] Among those published are the following: St. Louis–San Francisco RR, *Railway Age*, Vol. 56, No. 11 (March 13, 1914), p. 503 (this is the earliest published traffic density map that I have found, though there may be earlier ones); Illinois Central RR, *Railway Age*, Vol. 130, No. 7 (Feb. 12, 1951), p. 103; Western Maryland Ry, *Trains*, Vol. 14, No. 5 (March, 1954), p. 56; Louisville and Nashville RR, *Trains*, Vol. 15, No. 5 (March, 1955), p. 23; Chicago, Burlington, and Quincy RR, *Trains*, Vol. 16, No. 1 (Nov., 1955), p. 23; Missouri Pacific RR, *Trains*, Vol. 17, No. 3 (Jan., 1957), p. 46; Chicago and North Western Ry. System, John H. Garland (ed.), *The North American Midwest* (New York: Wiley 1955), and also in *Modern Railroads*, Vol. 3, No. 10 (Dec.,

The following discussion of the pattern of railroad traffic densities is based on a group of concepts that were originally developed in a study of the New Zealand Government Railways.[13] These concepts are here tested by application to railroads in other parts of the world, especially to two rail systems that are not only very much unlike the New Zealand Railways, but also differ greatly from each other—the Chicago and North Western Railway System of the United States, and the lines of the East African Railways and Harbours Administration in Kenya, Uganda, and Tanganyika. The complex, 9,500 mile C&NW system is a part of the intricate railnet of the American Midwest; the 3,400 miles of the EAR&H are composed of a group of widely spaced tentacles reaching into the interior of East Africa. The New Zealand Railways' 3,500 miles of line form an open rail pattern which lies between the other two systems studied in complexity, though not, as we have seen, in traffic density.[14]

A study of the pattern of railroad traffic densities reveals two features that appear to be of particular significance to geography—regional railnets and several functional types of rail lines.

Regional Railnets

One of the basic features of complex rail systems is a division of the network of lines into a number of regional railnets. These regional railnets focus on major trade centers,[15] and the pattern of traffic on the individual lines forming the networks is characterized by a general increase in density toward the regional centers. In part this increase is the result of a tendency to cumulative increases in traffic as a major rail center is approached; that is, over sections of railway close to a rail center moves traffic travelling to and from the "outer" portions of the line; consequently, the "inner" portions of the railway tend to have relatively heavy densities. In addition, main lines serving regional rail foci "funnel" branch-line traffic to and from the regional center, and this function also increases the intensity of main-line activity. Furthermore, there is usually, but not invariably, an increase in local traffic[16] that accompanies an increase in the general intensity of human activity with proximity to a regional center.

Regional railnets are separated by cols of low traffic density which approximate the hinterland boundaries of the focal cities. The traffic moving through these low density cols is composed largely of bridge traffic that flows from one regional railnet to another, often moving between the respective regional rail centers themselves.

In New Zealand, where the island character of the country enforces a twofold division of the railway system,[17] there are four regional railnets, two on the North Island and two on the South Island (see Fig. 3).[18] These regional rail systems focus on the four main urban centers of the country: Auckland and Wellington on the North Island, and Christchurch and Dunedin on the South Island. The four regional rail centers are the principal ports of New Zealand, and in addition they are the centers of internal commerce and manufacturing. The pattern of railway traffic, with its regional railnets, reflects the way in which the four major urban areas have extended

1948), p. 41; East African Railways and Harbours Administration, *Staff Magazine* (East African Railways and Harbours), Vol. 1, No. 4 (March, 1953), p. 13; general map of the main lines of the United States and Canada, Edward L. Ullman, *American Commodity Flow: A Geographical Interpretation of Rail and Water Traffic Based on Principles of Spatial Interchange* (Seattle: University of Washington Press, 1957), Frontispiece.

[13] William H. Wallace, "A Geography of the New Zealand Government Railways," Ph.D. dissertation, University of Wisconsin, Madison, 1956, and William H. Wallace, "New Zealand Railway Traffic Patterns," *New Zealand Geographer*, Vol. 13, No. 2 (Oct., 1957), pp. 130–150.

[14] Mileage figures for all three railroads are for 1955.

[15] The term "trade center" is here used to describe cities in which trade functions are important though not necessarily dominant activities.

[16] In terms of its movement relative to a particular railroad or section of line, all rail traffic may be grouped into one of four major classes: *local, originating, terminating,* and *bridge traffic. Local traffic* both starts and finishes its journey on the line under consideration. *Originating traffic* is loaded at a station on the line under consideration but is destined beyond its limits. *Terminating traffic* is consigned to a destination on the line under consideration, but was loaded at a point on another line. *Bridge* or *overhead* traffic neither originates nor terminates on the section of line under consideration.

[17] No train ferries, such as link the insular railnets of Japan, are operated in New Zealand.

[18] Until 1955, there was an isolated line in Nelson, on the South Island, making three railnets on that island (see Fig. 3). The Nelson Railway was abandoned on September 3, 1955.

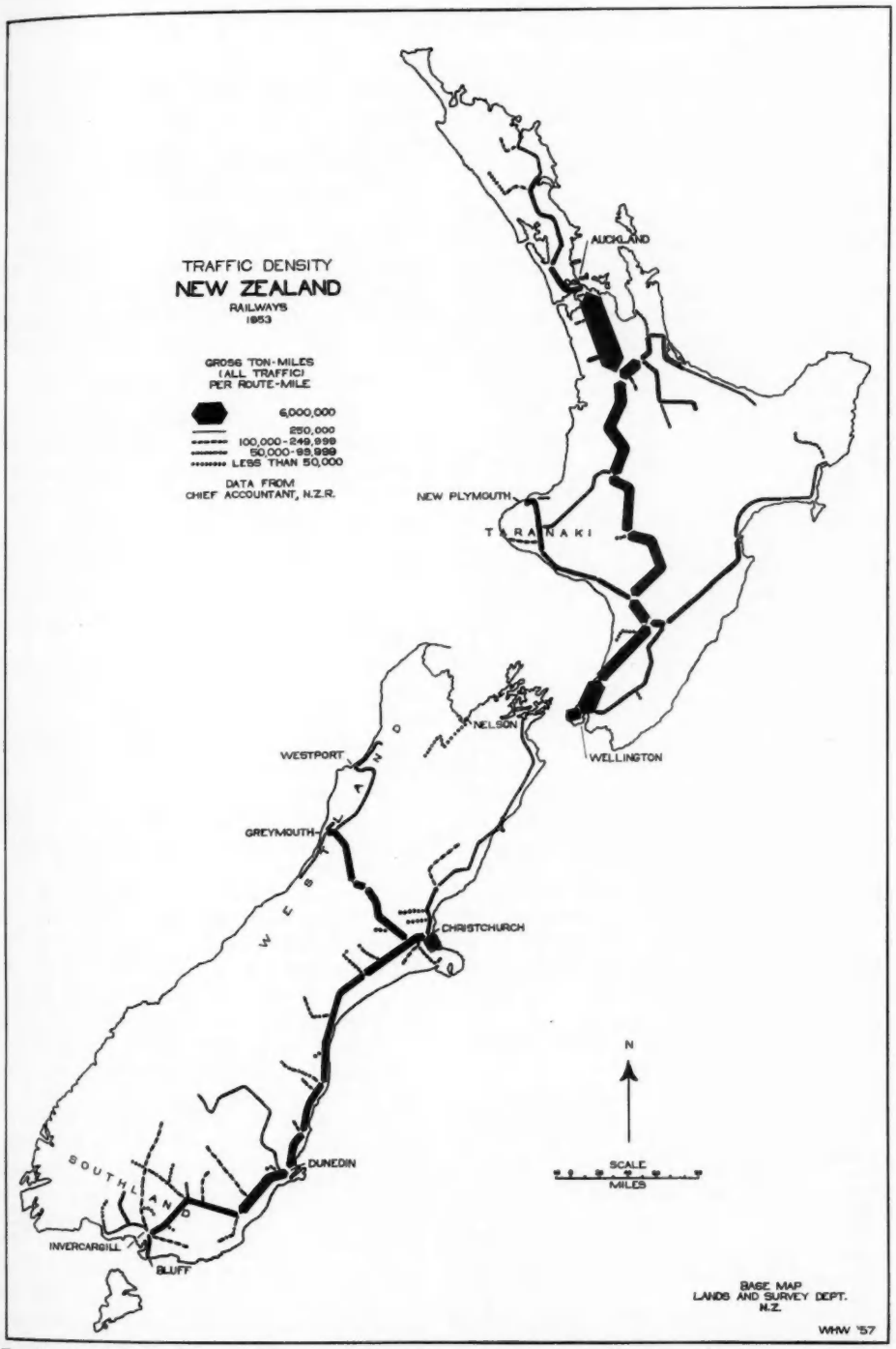

FIG. 3. Traffic Density on the New Zealand Railways. Four regional railnets, focussing on Auckland, Wellington, Christchurch and Dunedin, are revealed by the pattern of traffic densities. Each regional railnet is separated from its neighbor by cols of low traffic density.

their hinterlands over the country. Since railways, rather than coastal ships, are the major means of internal transportation, the "port-oriented" rail traffic pattern is also a reflection of the export-import nature of the New Zealand economy.

The rudimentary rail pattern of British East Africa has no regional railnets (Fig. 4). On each of the four lines that penetrate the interior, there is a continuous increase in traffic intensity toward the coast, but branch lines are few and the railways terminate in four separate ports rather than converging on a single port that might be considered as a regional rail center.

In Australia, the division of the railways into regional railnets is striking. Here, as in New Zealand, the type and distribution of economic activity, and the consequent pattern of population has led to the development of a group of port-centered regional railnets. However, the evolution of Australian regional railnets has also been fostered by the establishment of separate government railway systems in the various states; and, moreover, the lack of cooperation among these state railways has resulted in differences in track gauge and equipment that have helped to maintain the integrity of the regional railnets and have made hinterland boundaries rigid.

The intricate American rail pattern may also be considered as a group of regional railnets. In the United States, railnets focus upon two basic types of urban areas—ports and internal trade centers. The port rail centers[19] include the major Atlantic, Gulf, and Pacific Coast harbors, and also the principal Great Lakes ports. The internal trade centers on which regional railnets focus[20] include Midwestern cities, such as Chicago and St. Louis, southern points like Atlanta and Birmingham, and western foci like Salt Lake City-Ogden, and Spokane. In every case, the regional rail centers, whether port or internal, are important concentrations of population, commerce, and manufacturing, and their hinterlands extend over major sections of the country.

Regional railnets are a basic feature of complex rail patterns in all parts of the world. Only where railroads are limited to a few isolated tentacles, usually linking ports with interior areas, are regional railnets absent.

Functional Types of Railroad Lines

One of the most important aspects of the geography of a railroad is the functions of its various lines. Understanding of these functions may be aided by a system of classification that was developed in a study of the railways of New Zealand and has been modified for application to other railroads. This scheme is based on rail traffic patterns as revealed by variations in densities and directions of flow. It classes railroad lines into eight types.

In the discussion of the classification, reference will be made to various types of rail centers, some of which have been mentioned in the preceding discussion of regional railnets. Since the identity of main lines is determined by the terminals which they connect, it will be necessary to attempt a more precise definition of the various types of railroad centers.

In all but the most rudimentary rail systems there are a considerable number of focal points. In a complex railnet like that of the United States, there are countless rail centers, junctions, and line crossings, but it is also true that only a relatively small number of these foci have regional importance; the vast majority are only of local significance. The problem is to establish a hierarchy that reflects the differing importance of regional and local rail centers. Because the "texture" or intricacy of railnets varies greatly from region to region and from country to country, it is not possible to set exact and universal limits for the various types of rail centers in terms of converging lines or volumes of traffic interchanged. Thus, in New Zealand the four first-order rail centers, all ports, each have but one line with inter-regional functions, and the number of converging main lines at these centers ranges from two to four. In complex railnets, like those of the United States, first-order rail

[19] Port rail centers are here defined as places where there is an important functional relationship between rail and water carriers, and where the connection with water transportation is a major factor in the existence of the rail center. Thus cities like Cincinnati, St. Louis, and Chicago, though they are ports, are not considered "port rail centers" because there the rail–water connection is not a major factor in railroad activity. The development of the St. Lawrence Seaway may, of course, change the relationship at Chicago.

[20] In railroad terminology, some of these regional rail centers are referred to as "gateways," for they are the points of contact between rail systems serving the various regions of the country, and they function as nodes of interchange between these railroads.

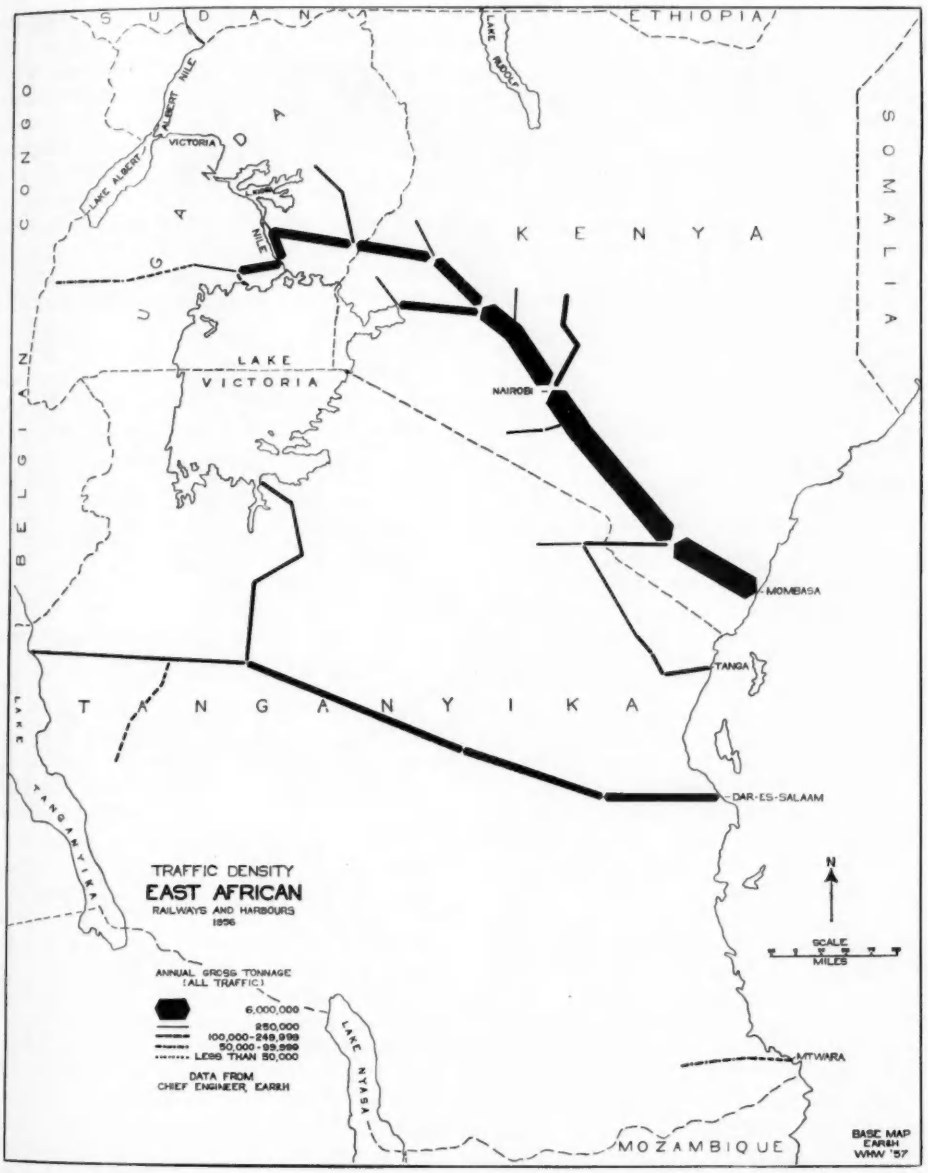

FIG. 4. Traffic Density on the Lines of the East African Railways and Harbours Administration. On this rudimentary system, traffic focuses on four separate Indian Ocean ports and there are no regional railnets.

centers have many more converging lines and extra-regional connections. In the United States, the problem of classifying rail centers is made difficult not only by the intricate nature of the rail pattern, but particularly because the lines of a large number of separate railroad companies must be considered as they function within the systems of which they are a part, and also in terms of their relationships with the lines of other systems which they meet at a host of points.

It is not the purpose of this paper to attempt

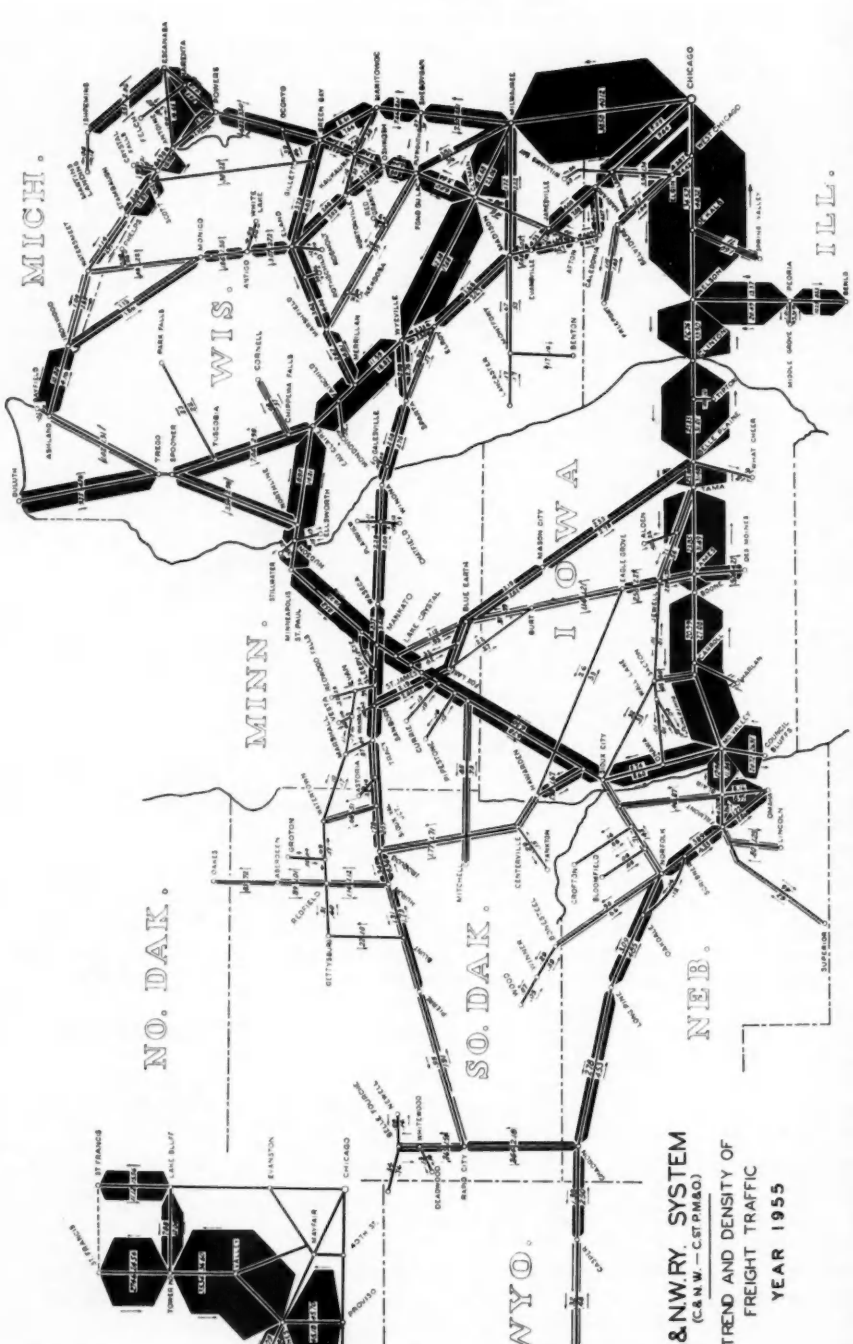

FIG. 5. Freight Traffic Density on the C.&N.W. Ry. System (Courtesy of the C.&N.W. Ry. System). The pattern of traffic densities on a single American railroad system suggests the role of Chicago, Omaha, Minneapolis–St. Paul, and Duluth–Superior as regional rail centers. Six second-order railroad centers are also shown: Peoria, Des Moines, Sioux City, Milwaukee, Escanaba, and Ashland.

a complete classification of the focal points in the American railnet, but rather to suggest certain groupings which may prove useful in understanding rail centers and the lines which connect them. The categories which will be discussed are tentative and should be subjected to further investigation.

First-order or regional rail centers are the major trade centers and/or primary ports of the regions in which they are located.[21] The following criteria are suggested for American first-order port railroad centers: *first*, the presence of a number of converging railroad lines with inter-regional functions; *second*, a large volume of traffic interchange between rail and water carriers, with the rail-water connection a major feature of railroad activity; *third*, and of subordinate importance, though still significant, an interchange of traffic between different railroad systems, or between different lines of the same system. The volume of such interchange might be evidenced by such features as major classification or marshalling yards, belt railways, and separate terminal and transfer railroad companies. A tentative list of first-order port rail centers of the American railnet might include Boston, New York, Philadelphia, Baltimore, the Hampton Roads ports, New Orleans, Houston–Galveston, Los Angeles, San Francisco, Portland (Oregon), Seattle, and, on the Great Lakes, Duluth–Superior and Toledo.

The criteria for internal regional rail centers should be similar, except that: (1) rail-water interchange would, of course, not be a major factor in the activity of the center, and (2) because of the lack of large-scale rail-water interchange, the number of converging rail lines having inter-regional functions, the volume of traffic interchange among railroad systems or the lines of one system, and the facilities for this interchange should be larger than in a port rail center of comparable importance. A preliminary list of American internal regional rail centers follows: Richmond, Jacksonville, Atlanta, Birmingham, Memphis, Louisville, Cincinnati, Cleveland, Detroit, Buffalo, Pittsburgh, Chicago, St. Louis, Kansas City, Omaha, Minneapolis-St. Paul, Dallas-Ft. Worth, Denver, Salt Lake City-Ogden, and Spokane. Some first-order rail centers, such as Buffalo, Cleveland, and New Orleans have a duality of function that might justify their classification as either port or internal foci, and this problem warrants further attention.

In addition to the regional or first-order rail centers just described, railnets contain a great number of lesser foci, ranging from minor junctions, where a single branch diverges from a main line, to second-order rail centers which, in numbers of converging lines and traffic interchange, are but little inferior to first-order centers. Second-order rail centers may be cities that are second-ranking trade centers, or they may be secondary ports with important rail connections. As with regional foci, the number of converging lines and volume of traffic interchanged vary with the complexity of the railnet. In the parts of the Midwest served by the C&NW system, Milwaukee, Peoria, Des Moines, Sioux City, and the ports of Escanaba and Ashland may be classed as second-order rail centers (see Fig. 5). In New Zealand, where the rail pattern is less complex, second-order rank would go to four cities, Hamilton-Frankton, Palmerston North, Greymouth, and Invercargill, which are served by only two or three main lines, but which have marshalling yards and are important interchange points (see Fig. 7).

Ranking lower in the hierarchy are countless junctions where two or more railroad lines come together. Points at which two or more railroads intersect but do not interchange traffic should not be considered junctions but merely "crossing points" because there is no functional relationship between the lines involved. Among junctions, it is desirable to distinguish between major ones, where two or more main lines and possibly some branch lines converge and interchange traffic, and the more numerous minor junctions that are reached by but a single main line and are marked only by the divergence of branches.

According to their functions, railroad lines may be classed into the following types: *trunk lines*, two types of *main lines*, four types of *branch lines*, and *isolated lines* (see Fig. 6).

The most important type of railroad line is the trunk line, which links regional railnets and connects first-order rail foci, which may be ports or internal centers. Trunk lines usually serve as a base for one or more diverging

[21] See Robert E. Dickinson on the "Metropolitan Cities" and the "Metropolitan Regions" of the United States in *City Region and Regionalism* (London, 1947), Ch. 7, pp. 200–23.

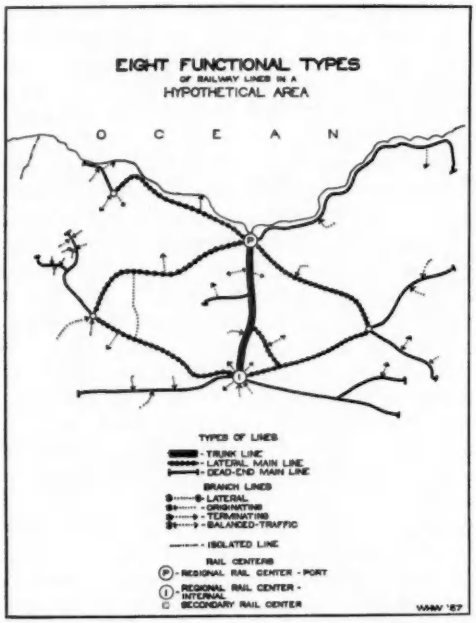

FIG. 6. Eight Functional Types of Railway Lines in a Hypothetical Area. The *trunk line* connects two first-order rail centers—a port and an internal center. Several *lateral main lines* link lesser rail centers. A number of *dead-end main lines* which have but one connection with a rail center are also shown. The four types of *branch lines* may be identified by the arrows at their termini. A solitary *isolated line* appears at the upper left of the map.

branches, but this is not an essential characteristic. On trunk lines, the density of traffic increases toward the major traffic foci, and in consequence, trunk line densities commonly exhibit a "bi-polar" or more complex pattern. In addition to the usual local, originating and terminating traffic, bridge traffic constitutes an important part of total activity on many trunk lines, particularly within the cols of low traffic density that separate regional railnets.

Main lines are the second basic element of railroad systems; they connect important traffic centers, and from them other lines diverge. Two types of main lines are recognized—lateral and dead-end. Lateral main lines usually link first-order rail centers with secondary centers, or connect two or more secondary centers, but some do no more than connect junctions. From lateral main lines, branches or other main lines diverge, and on this type of railroad a "bi-polar" or more complex traffic pattern is common. As a rule, bridge traffic makes up an important part of the movements over this type of main line.

Dead-end main lines usually have but one connection with a major or second-order rail center, or major junction, but their distinctive characteristic is that they terminate at points lacking significant rail connections and traffic interchange. From such railways, branches and other main lines diverge, and on lines of this type there is usually a general increase in traffic toward the originating junction or inner terminal—a traffic density pattern that may be described as "mono-polar." Bridge traffic is not usually important on dead-end main lines. Their activity is made up primarily of local, originating, and terminating movements, a considerable part of which may be funneled to and from tributary lines.

A few rail systems consist almost entirely of trunk lines and main lines, but this type of pattern is unusual. Railroads serving well-peopled, productive areas usually have numerous branch lines. The essential characteristic of all branch line railroads is that they diverge from main lines, and are not themselves trunks for diverging branches. Branch lines are usually characterized by relatively light traffic densities, but there are exceptional branches that have very heavy traffic, heavier, indeed, than many main lines. It seems that the fundamental distinction between branch and main line must be in terms of *route pattern* and is implied by the word "branch"—the former diverges from the latter. This distinction is not simply or invariably one between light and heavy traffic lines, and since any division between light and heavy traffic can only be arbitrary, and would vary from railroad to railroad, it seems unlikely that a satisfactory classification can be based on this criterion. However, it is sometimes difficult to determine which of two diverging lines is the branch. The answer to this question may best be sought in the functional relationship of the two lines, the pattern of train operations and traffic density patterns: the railroad with the heavier traffic should be classed as the main line; the lighter traffic line may be considered as a branch of the main line.

In terms of their functions, branch lines may be grouped into four classes: originating or feeder branches, terminating branches, bal-

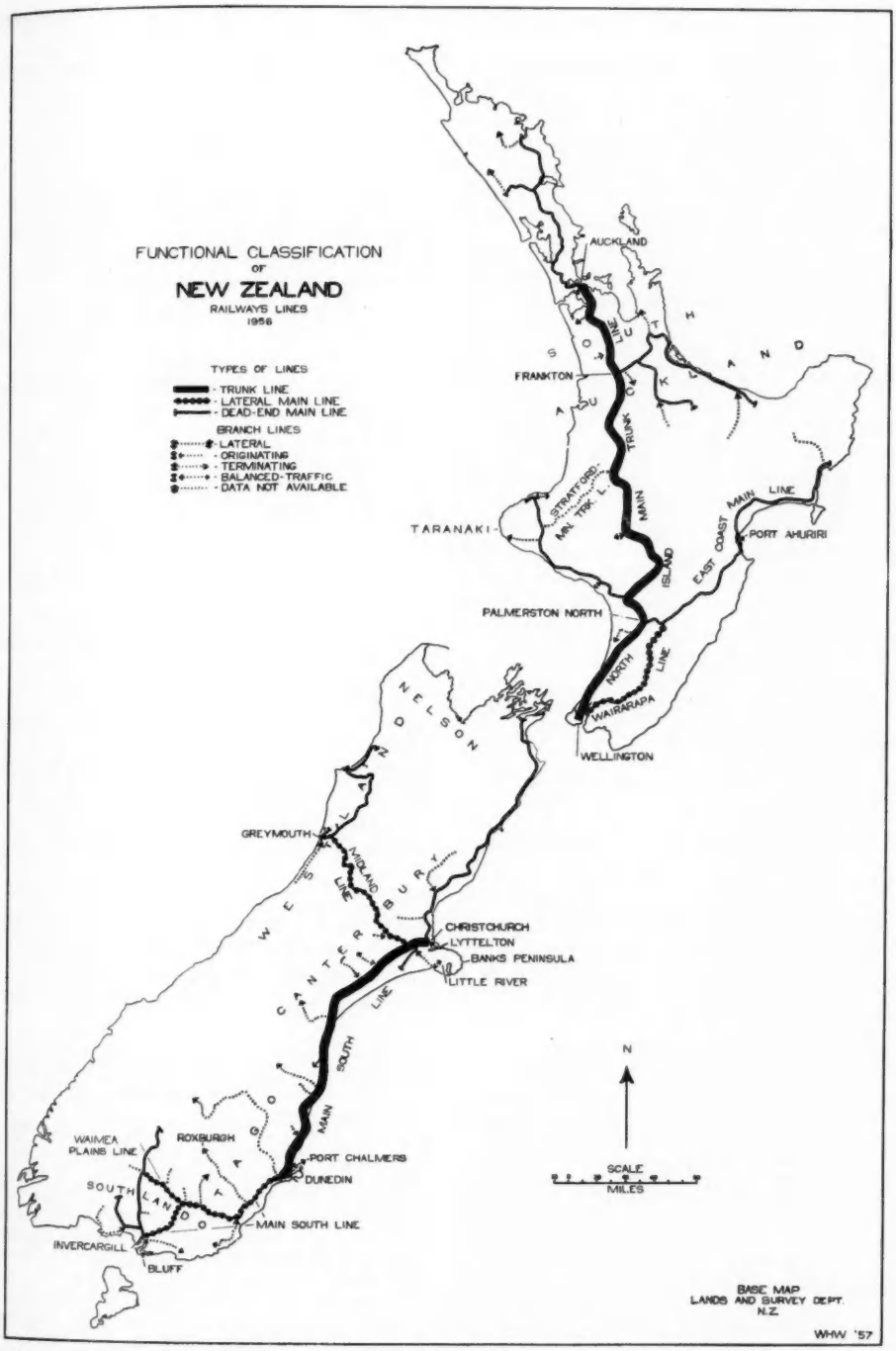

FIG. 7. Functional Classification of the New Zealand Railways Lines. In this system there are but two trunk lines which connect the regional rail centers on each island. Four lateral main lines link lesser rail centers. Dead-end main lines are a common feature, and many of them tie secondary urban places to rail centers. The numerous branch lines are classed according to their functions.

anced-traffic branches, and lateral branches. Lateral branches are similar in pattern and function to the lateral main lines that have already been described. This type of railroad links two or more main line junctions, and over its tracks traffic flows to and from both terminals. The three other types of branches are dead-end lines. Feeder or originating branches play the role that is generally assumed to characterize branch lines. They exist primarily to connect traffic sources with main lines, and on these branches the dominant direction of movement is toward the main lines — originating traffic is preponderant. Terminating branches perform a precisely opposite function — they act chiefly to distribute traffic from main lines to receiving depots. Thus, on these lines, terminating traffic moving away from the main line is the outstanding feature. As will be seen, terminating branches are surprisingly common. A third type of dead-end branch, which may be called a balanced-traffic line, is also sufficiently common to warrant consideration as a separate class. On branches of this type inward and outward traffic flows are so nearly equal that designation as either feeder branch or terminating branch would be misleading.[22]

Scattered over the world, primarily in areas having rudimental rail systems, is a fourth type of line—a single, isolated railroad, often having at least one terminal at a port. Lines of this sort do not link major rail centers and are without branches; consequently they can not be classed as trunk or main lines. On the other hand, they have no connection with a main line and thus cannot be called branches. This type of railroad may be referred to as an "isolated line" (Fig. 6).

Functional Analyses of Three Railroad Systems

The classification of railroad lines that has been presented will now be demonstrated by its application to three railroad systems: the New Zealand Government Railways, the Chicago and North Western Railway System, and the railways of the East African Railways and Harbours Administration.

The New Zealand Government Railways. According to their functions, the lines of the New Zealand Government Railways may be classified as shown on Figure 7. There are but two trunk lines in New Zealand, and they form the backbone of the railnets of the two main islands. The North Island Main Trunk Line connects the two first-order rail centers of the North Island, Auckland and Wellington, and links up the regional railnets that focus on these cities. Similarly, on the South Island, the Main South Line connects the two major rail centers, Christchurch and Dunedin, and joins the regional railnets tied to these cities.

Dead-end main lines are a common feature of the New Zealand railnet. This type of railway usually ties secondary urban places to one of the four regional rail centers of the country.

In the New Zealand railnet there are four lateral main lines. The most important of these is the Midland Line, which links the coal and timber carrying railways of Westland with the populous eastern part of South Is-

[22] In order to define meaningful class limits that would separate balanced-traffic branches from other types of lines, a survey was made of traffic trends on one thousand branch lines in forty railroad systems in all parts of Anglo-America, Cuba, British East Africa, and New Zealand. For each line the proportion of total traffic that moved outward was determined. These data, expressed as percentages of total traffic, were then plotted on frequency graphs and class limits were defined at low points in the distribution curves. It was found necessary to define separate class intervals for branches whose traffic data were expressed in *net* tons or *net* ton-miles and for those lines whose traffic statistics were given in *gross* tons or *gross* ton-miles. This differentiation is necessary because *gross* traffic figures include the weights of freight cars, and, in some cases, locomotives and passenger equipment; since rolling stock usually makes a round trip over any branch on which it moves, *gross* traffic data necessarily reveal trends that are more nearly in balance than those indicated by statistics for *net* traffic in goods, which normally make only one-way trips.

In accordance with this procedure, the following classes have been defined and found useful for the functional classification of branch lines. On systems for which *net* tons or *net* ton-mile traffic data are given: *originating* or *feeder branch*—traffic is more than 60 percent outward; *balanced-traffic branch*—traffic is between 40 percent and 60 percent outward; *terminating branch*—traffic is less than 40 percent outward. On systems for which traffic statistics are expressed in *gross* tons or *gross* ton-miles: *originating branch*—outward traffic is 55 percent or more of total traffic; *balanced-traffic branch*—outward traffic is less than 55 percent but more than 45 percent of total traffic; *terminating branch*—outward traffic is 45 percent or less of total traffic.

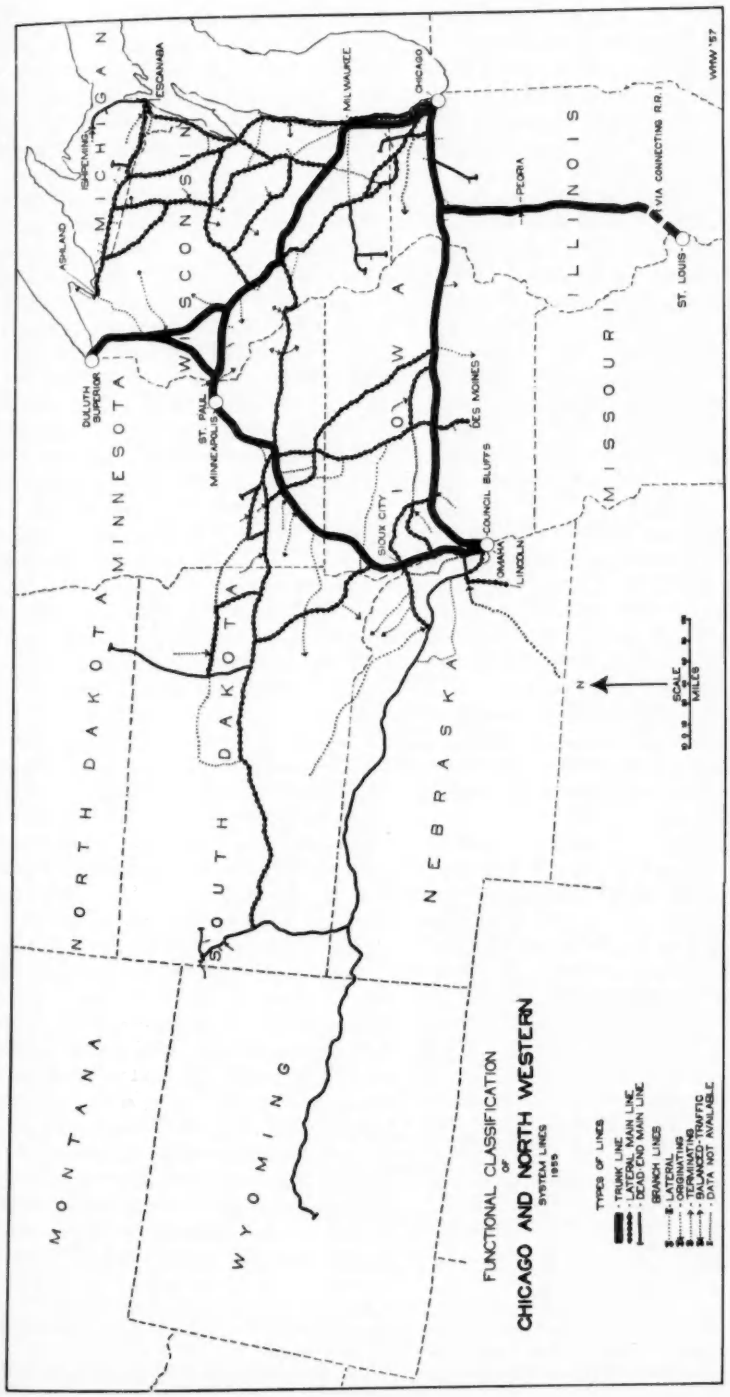

FIG. 8. Functional Classification of the Chicago and North Western System. The basic feature of this system is the group of six trunk lines that link five Midwestern first-order rail centers. Lateral main lines are very numerous in this complex railnet, but dead-end main lines are relatively uncommon —most of them reach out to the periphery of the Midwest. Nearly ninety branch lines are classed according to their functions.

land. South of Dunedin, the Main South Line functions as a lateral main line, connecting the railways of Southland and southern Otago with the regional rail center at Dunedin. Also of considerable significance is the Wairarapa Line[23] which provides an alternative route between Wellington and the East Coast Main Line.

Nearly a third of the mileage of the New Zealand Railways consists of branch lines, and functionally these are of four distinct types: lateral branches, originating or feeder branches, balanced-traffic branches, and terminating branches. The term "feeder branch" should be used with discretion in describing the lines of the New Zealand Railways. During the period studied,[24] hardly more than a quarter of the branch lines in New Zealand delivered a tonnage to the rest of the system that exceeded the quantity of traffic they received from the main line. Of the thirty-five New Zealand Railways branch lines for which data were available, sixteen were terminating lines, eight were balanced-traffic branches, and only ten could be classed as originating or feeder lines (see Fig. 7).[25] Only one lateral branch is found in the simple New Zealand rail pattern. This railway, the Stratford-Main Trunk Line, connects Taranaki with the Auckland regional railnet and carries a considerable volume of bridge traffic between these regions.

The Chicago and North Western Railway System. The New Zealand railnet is relatively simple in comparison with the Chicago and North Western Railway system, which covers the northern Midwest with an intricate network of lines (Fig. 8). The complexity of this system, the presence of many competing railroads, the interior position of the Midwest, and the nature of human activity in this region combine to give the C&NW a traffic pattern very different from that of the NZR.

The basic elements of the Chicago and North Western system are six trunk lines that connect the five Midwestern first-order rail centers served by the railroad: Chicago, St. Louis, Omaha–Council Bluffs, Minneapolis–St. Paul, and Duluth–Superior (see Fig. 8). These trunk lines are the principal traffic arteries of the railroad, and a glance at the density map (Fig. 5) reveals their dominance in the freight movements of the system.

In striking contrast to the rudimentary New Zealand railnet, the complex C&NW pattern contains twenty-seven lateral main lines. Some of them are residual portions of once-competitive railroads that were acquired by the C&NW as the system was formed.[26] The lateral main lines of the C&NW are, in general, characterized by traffic densities considerably lighter than are prevalent on the trunk lines of the system.

The dead-end main lines that are such a conspicuous feature of the New Zealand railnet are relatively uncommon on the Chicago and North Western, where there are but eleven such lines in the entire system. Most of these railways penetrate areas that are peripheral to the most populous and productive sections of the Midwest—the Great Plains, Upper Michigan, southwestern Wisconsin.

The complex C&NW railnet includes nearly ninety branch lines and, unlike the NZR, a large proportion of these are lateral branches. Twenty-six lateral branches link up main lines on all parts of the system; lateral branch lines are most common where main lines are closely spaced—near major rail centers and in closely-peopled, intensively utilized areas. Sixty-three[27] dead-end branches complete the C&NW rail pattern. Among these, terminating branches are almost as numerous (15) as feeder lines (18), while balanced traffic lines

[23] The Wairarapa Line has become, functionally speaking, a lateral main line only with the completion of the Rimutaka Tunnel and low-gradient deviation in November, 1955. For many decades prior to this date, the difficulties of handling heavy traffic over the Rimutaka Incline had caused the Wellington–Masterton section of the Wairarapa Line to function as a dead-end main line focusing on Wellington; the portion of the Wairarapa Line north of Masterton served as a branch of the East Coast Main Line which it joins at Woodville. Since the completion of the tunnel and deviation, through traffic to and from northern parts of Eastland has been routed via the Wairarapa Line rather than via Palmerston North, and the density of traffic on the Wairarapa Line has approximately doubled.

[24] The period studied is the year ended March 31, 1956.

[25] In addition to the thirty-five New Zealand Railways branches for which data are available, there are fifteen lines that cannot be considered here because statistics covering their inward and outward traffic are lacking.

[26] See Robert J. Casey and W. A. S. Douglas, *Pioneer Railroad, the Story of the Chicago and North Western System* (New York, 1948).

[27] Data permitting classification as to traffic trends are available for only thirty-nine of these lines.

make up approximately one-sixth (6) of the total.

The East African Railways. The classification scheme that has been used in the analysis of the New Zealand Railways and the Chicago and North Western System may also be applied to the simple rail pattern of British East Africa (Fig. 9).[28] There is, of course, a profound contrast between the East African Railways and Harbours system, composed of a few tentacles and branches, and the complex railnet of the C&NW, or even the rudimentary New Zealand railnet (Figs. 7 and 8). Because there are no regional railnets in East Africa and because the foci of railways are four widely separated ports on the Indian Ocean, this rail system lacks trunk lines. The primary features of the EAR&H rail pattern are three dead-end main lines that connect seaports with the interior. The two northern main lines are connected by a lateral main line, but the southern line is isolated from the other main line railways.[29] Two additional dead-end main lines diverge from other main lines at junctions in the interior and terminate at lake ports. These six railways carry most of East Africa's rail traffic and, from them, twelve branch lines diverge.

The remaining part of the EAR&H system is the isolated line in southern Tanganyika (see Fig. 9). On the Southern Tanganyika Line, the trend of traffic is seaward, toward the port terminal of Mtwara, and thus this line might be considered as a "feeder" in its functional relationship to the general pattern of transportation in East Africa.

Generalizations on the Functional Types of Railroad Lines

The eight-category functional classification of railroad lines that was presented and applied to three diverse rail systems seems to reveal some significant characteristics of these railnets. Having demonstrated the application of this classification, it now remains to formulate generalizations on the factors that determine the character and occurrence of each type of line.

Trunk Lines. Trunk lines are characteristic only of railroads that serve areas having more than one important regional center. They are most common in regions where the rail pattern is complex, usually in response to high population density and a high level of production and consumption. Also, trunk lines are features of rail systems that carry large volumes of internal traffic,[30] that is, goods and people moving between regional railnets or between major rail centers. A considerable flow of internal traffic is possible only where large quantities of goods move from producing areas within the hinterland of the railnet to markets that are also served by the rail system. Consequently, such traffic is not likely to be strong in an area where trade is focused upon ports whose primary function is to provide access to overseas markets or foreign suppliers. Trunk lines are likely to be best developed in rail systems that serve regions having complementary rather than competitive economic activities.

As a result, trunk lines are common features of the railnets of the United States, Canada, Europe, western parts of the Soviet Union, South Asia, and Japan. A few trunk lines also exist in Mexico, southern portions of South America, the Middle East, North Africa, South Africa, Australia, New Zealand, Java, China, and Korea, but this type of railroad is absent in central portions of Latin America, most of Africa, and parts of Southwest and Southeast Asia.

Lateral Main Lines. Lateral main lines are a common feature of intricate, closely woven railnets. Lines of this type appear to be the result of several factors, which often act in combination. Among these, one of the most important is the existence of a complex traffic pattern within the areas served by the railroad; that is, traffic movements that focus not on one or two centers but rather flow between a number of competitive centers. The presence of many lateral main lines is also indicative of a vigorous internal movement of goods.

Some lateral main lines have been built specifically for the purpose of linking other main lines in a system, and thus to provide

[28] The railways of Kenya, Uganda, and Tanganyika are all operated by the East African Railways and Harbours Administration.

[29] It should be noted, however, that marine services on Lake Victoria, in addition to tying the lake littoral to the various railheads, provide a connection between the Kenya–Uganda railways and those of Tanganyika.

[30] The term "internal traffic" is used to distinguish traffic moving within the zone of a continuous railnet—either that of a single country (Japan) or a continent (North America)—from the "external traffic" that moves to and from exporting and importing ports.

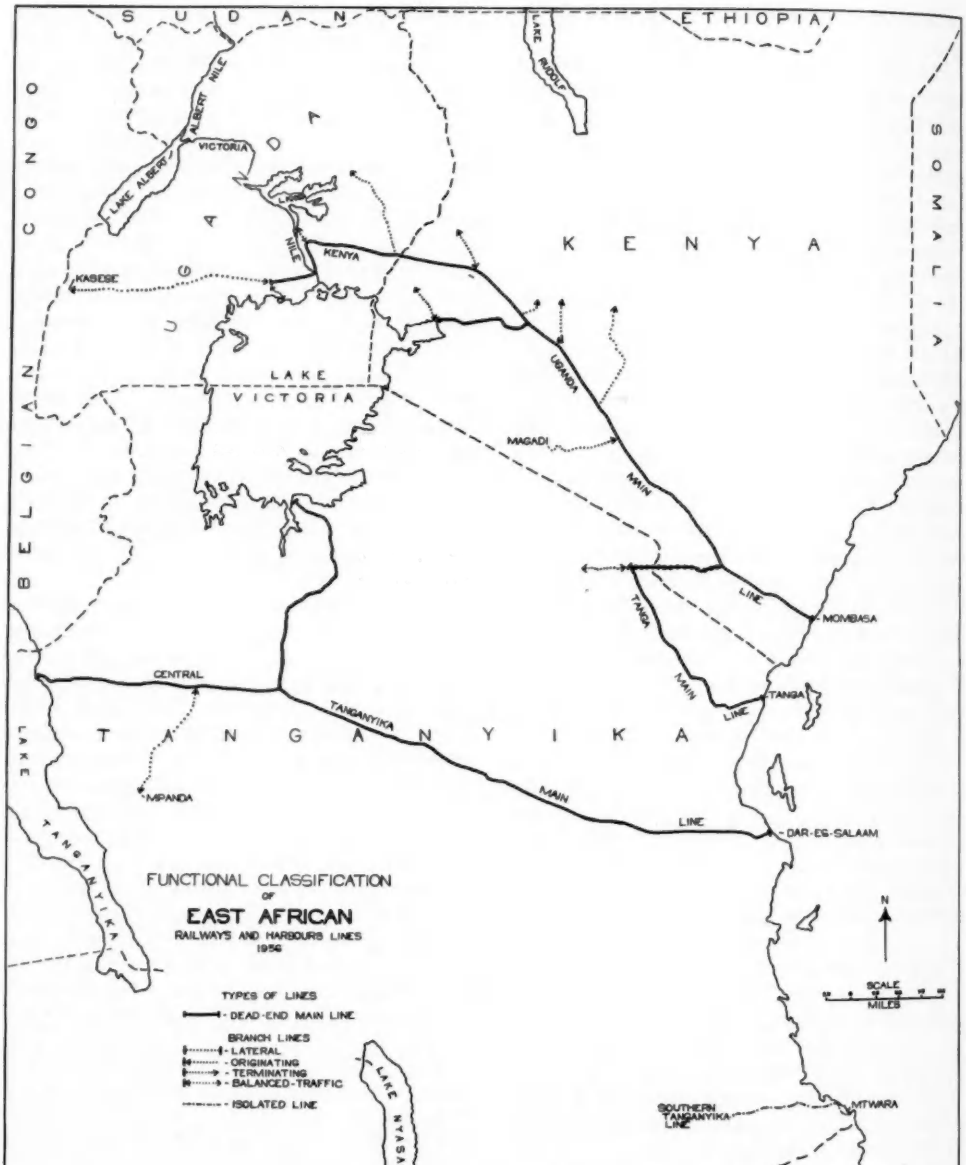

FIG. 9. Functional Classification of the Lines of the East African Railways and Harbours Administration. Trunk lines are lacking, and this simple rail pattern is dominated by dead-end main lines penetrating the interior of East Africa. Two of these are linked by a lateral main line. A dozen branches diverge from the main lines. Note the isolated Southern Tanganyika Line.

more direct routes between secondary traffic centers. Not a few of these railroads provide bypasses around congested terminals in major rail centers. However, in the United States and in the two other railnets that were analyzed in this paper, a large proportion of the lateral main lines are remnants of separate, once-competitive railroads that have lost their identity through consolidation with rival systems.[31]

Over the world, the general distribution of lateral main lines coincides with that of trunk lines. Thus this type of railroad forms an important part of the railnets of Anglo-America and Europe, is less common in areas where the intensity of human activity is intermediate, and is, of course, totally lacking in the rudimentary tentacular rail patterns in parts of Latin America and southwest and southeast Asia, and in much of Africa.

Dead-end Main Lines. Dead-end main lines are a much more important part of rudimentary railnets than of complex rail systems. Thus, lines of this type make up but a minor part of the intricate rail patterns that have been discussed, but they form an important portion of the railways of southern South America, South Africa, Australia, and New Zealand and are the dominant element of the rail pattern in all scantily-railed areas.

Many of the world's dead-end main lines form links between ports and their hinterlands in areas where internal traffic is relatively little developed but external or foreign trade is of great importance, such as Africa, South America, Australia, New Zealand, and Alaska.

The dead-end main lines of interior regions tie commercial and industrial centers with portions of their hinterlands in which population density and productivity are low and where competition from rival foci is slight. In Anglo-America a number of iron ore-carrying railroads that terminate in lake ports are of this type. In the United States and Canada, most of the dead-end main lines extend from the fringes of highly productive and populous regions into adjacent areas of less intensive activity—into the Great Plains and Rockies, to parts of the South Atlantic and Gulf Coasts, into scattered areas in northernmost United States from Maine westward to the Rockies, to the northern fringe of settlement in Canada, and also onto Long Island. Elsewhere in Anglo-America, dead-end main lines are relatively uncommon because main lines rarely terminate without reaching a significant traffic interchange point or gateway.

Branch Lines. The four functional types of branch lines also have characteristic locations that reflect their functions. The distribution of lateral branches is governed by the same general factors that affect lateral main lines: the presence of complex traffic flows, vigorous internal traffic on the railway system, large competing trade centers, and construction by rival railroad organizations.

Dead-end branches, as we have seen, may be originators, balanced-traffic lines, or terminators. The majority of the terminating branches that are surprisingly numerous in the three railway systems studied have at least one common characteristic—they serve hinterlands having relatively large populations. Most of these lines are of three types. A large number of terminating lines, both in New Zealand and in the American Midwest, serve minor trade centers in intensively farmed areas from which livestock and livestock products are the primary commodity shipped. Another type of terminator acts primarily to link urban places, in which manufacturing is generally a prominent activity, to main lines. On branches serving such areas as the wool sheep-rearing interior of the South Island of New Zealand or the coffee- and cotton-producing districts of East Africa, in which the products for shipment are primarily of the lightweight, high-value type, the trend of traffic is also likely to be away from the main line junction. In each of these situations, the outward movements, based primarily on local production, are outweighed by the influx of supplies for agriculture, manufacturing, and consumers.

Feeder branches in New Zealand, the American Midwest, and East Africa are much less common than has generally been assumed. In general, originating branches serve areas with relatively small populations and a consequently small demand for goods. Many originating branches have hinterlands

[31] See George P. Baker, *The Formation of the New England Railroad Systems* (Cambridge, Mass., 1937), and also Casey and Douglas, *op. cit.*; and Irene S. Van Dongen, *East African Transport*, Univ. of Chicago Department of Geography, Research Paper No. 38 (Chicago, 1954).

that are dominated by extractive activities, particularly mining and timber cutting. Lines that serve regions in which bulky cash crop production or livestock rearing is a major part of agricultural activity are also apt to be originators, particularly if they reach no large urban population concentrations.

Balanced-traffic branches are also common features of the rail systems studied. This type of line serves areas which have some characteristics in common with districts that are tributary to feeder branches, and other features that are similar to the hinterlands of terminating branches. In general, the inward or outward traffic trend that may be described as "normal" in a given type of situation is counterbalanced by secondary economic or population factors. Thus, urban branches, which would normally be terminators, may be given balanced traffic trends by manufacturing based on locally-produced raw materials, often from nearby farms. Lines serving minor trade centers in well-populated, intensively farmed areas may have the usual inward traffic trend balanced by shipments from local small-scale extractive industries. On the other hand, branches in districts devoted to the production of bulky cash crops, or to mining or logging, a condition that usually produces outward trends, may achieve a balance in traffic movements because the demands of urban places are sufficient to match the outflow of local products.

CONCLUSION

This paper has essayed a general survey, with special emphasis on three diverse systems, of some aspects of railroads that appear to have particular significance to geography. Attention has been concentrated on the activity of railroads—their traffic—rather than on such "static" phenomena as route patterns, track alignment, structures, rolling stock, equipment, and so forth. This emphasis has been given on the assmption that the causal relations between rail activity and the other aspects of geography have greater significance and are more numerous than those inter-connections involving the "static" aspects of railroads.

Two fundamental aspects of rail traffic have been given special attention—densities and patterns. The intensity of rail traffic, or the *level* of traffic density, whether freight or passenger, should be considered as a reflection and, incidentally, as an index of the general character of human occupance in an area. As we have seen, an understanding of the level of railroad traffic density requires consideration of the population—its distribution, density, and characteristics, and investigation of the nature of the basic human activities, economic and otherwise, and also knowledge of the level of technology and standards of living in the areas involved.

Regional railnets provide an indication of the pattern of economic regions, as defined by the hinterlands of major urban centers. The concept of regional railnets also provides a basis for the study of complex rail systems in terms of major units, each centered on an important rail center.

The functional classification of railroad lines that was presented in this paper is intended to facilitate understanding of the role played by individual railroad lines in the activity of rail systems. Each type of line has a typical setting, relative not only to the railnet of which it is a part, but also in terms of the geography of the area in which it is found.

The generic concepts that have been introduced in this paper will, of course, require further testing in other areas, and are capable of refinement and subject to revision. Determination of the utility of these concepts will come only with further research in the field of transportation geography. Traffic data for all forms of transport are now more readily available than they have been in the past, and the time is ripe for more work in this area. It is the hope of the author that more geographic studies of rail traffic will be made, so that knowledge of this important part of geography may be enlarged and, incidentally, so that the validity and utility of the concepts presented in this paper may be tested.

WHEAT FAILURE IN WESTERN NEBRASKA, 1931-54[1]

LESLIE HEWES
University of Nebraska

BY reputation, dry farming is the shakiest leg of the tripod composed of dry farming, grazing, and irrigation which supports the rural economy of the Great Plains. Failure of wheat, the outstanding crop of dry farming in the central Great Plains, may be considered an outstanding index of risk in the region. Here, an evaluation of trends of the last quarter century in wheat failure and of factors involved in these trends is attempted.[2] In other words, a partial answer is attempted to the question: How wobbly is the dry farming leg of the tripod?

It is realized that considerations beyond the amount and degree of certainty of production are involved in the stability or instability of dry farming. Certainly prices and costs are of basic importance, as are credit and other matters.[3] Nevertheless, it seems safe to say that there are few measures as indicative of risk in an enterprise as wheat failure is of risk in dry farming in the central Great Plains. High failure, defined as failure of 30 percent or more of the planted acreage, is considered especially significant for the following reasons: First, the mapping of percentage of failure by counties throughout the state for the period 1931–54 shows that a notable increase of the *gradient* of failure occurs about the 30-percent isopleth. Second, in western Nebraska failure of 30 percent is near the break-even point between profit and loss for both summer-fallowed and continuous-cropped wheat.[4]

The area shown in Figure 1 includes all counties for which statistical records for continuous-cropped and summer-fallowed wheat were available for the years 1940, 1941, 1948–54, with the exception only of Sioux County, for which no record for 1941 was found.

In 1954, in western Nebraska only in Scotts Bluff, Sheridan, Sioux, Dundy, Frontier, Hayes, and Gosper counties did all other cultivated land equal the total of wheat and fallow, which together constitute *wheat land*. In all counties, wheat land gained in acreage at the expense of all other cultivated land during the period under study. In other words, wheat farming, predominantly dry farming, is of major importance and is now much more characteristic of western Nebraska than it was in 1931. The area mapped includes most of the dry-farmed wheat land of the state.

REDUCTION OF WHEAT FAILURE

Throughout western Nebraska, average failure of planted wheat was notably greater

[1] The investigation reported here was supported by a Research Grant of the Association of American Geographers. The work of the following assistants is acknowledged gratefully: Charles Gibson, Loyd Collier, Carolyn Hewes, and Philip Vogel.

[2] This is the second in a series of studies dealing with risk in the central Great Plains. The first, Leslie Hewes and Arthur C. Schmieding, "Risk in the Central Great Plains: Geographical Patterns of Wheat Failure in Nebraska, 1931–1952," *The Geographical Review*, Vol. XLVI, No. 3 (October, 1956), pp. 375–87, constitutes an introduction to the present study. It is intended to extend the investigation to adjoining parts of the central Great Plains in a subsequent paper.

[3] For example, E. L. Barber, "Meeting Weather Risks in Kansas Wheat Farming," *Agricultural Economics Department Report No. 44*, 1950, Kansas Agricultural Experiment Station, points out differences in how debt-encumbered owner, debt-free owner, and tenant have fared. Also, it is interesting to find that government agricultural programs strengthened dry farming during the period of depression and drought despite widespread wheat failure, as reported in H. L. Stewart, "Changes on Wheat Farms, 1931–37, with Special Reference to the Influences of AAA Programs," *Farm Management Reports No. 7* (June, 1940), Bureau of Agricultural Economics, Washington.

[4] The great majority of counties which show failure of 30 percent or more for the years for which records on failure and yield by practice are available (1940, 1941, 1948–54) had *real yields* (yields in terms of planted acres) of less than 10 bushels on summer-fallowed land and less than 6 bushels under continuous cropping. Also, the converse was true in the great majority of cases. According to a number of western Nebraska wheat farmers, the yields mentioned approximate break-even points. Harry G. Sitler, in "Economic Possibilities of Seeding Wheatland to Grass in Eastern Colorado," *Agricultural Research Series 43-64*, U. S. D. A., Agricultural Research Service, February, 1958, p. 23, found break-even yields on summer-fallowed wheat with wheat selling at $1.70 per bushel, and at 1954 costs, to be 7.6 bushels per acre, but his costs did not include interest on land or return to management. With failure, costs were reduced somewhat.

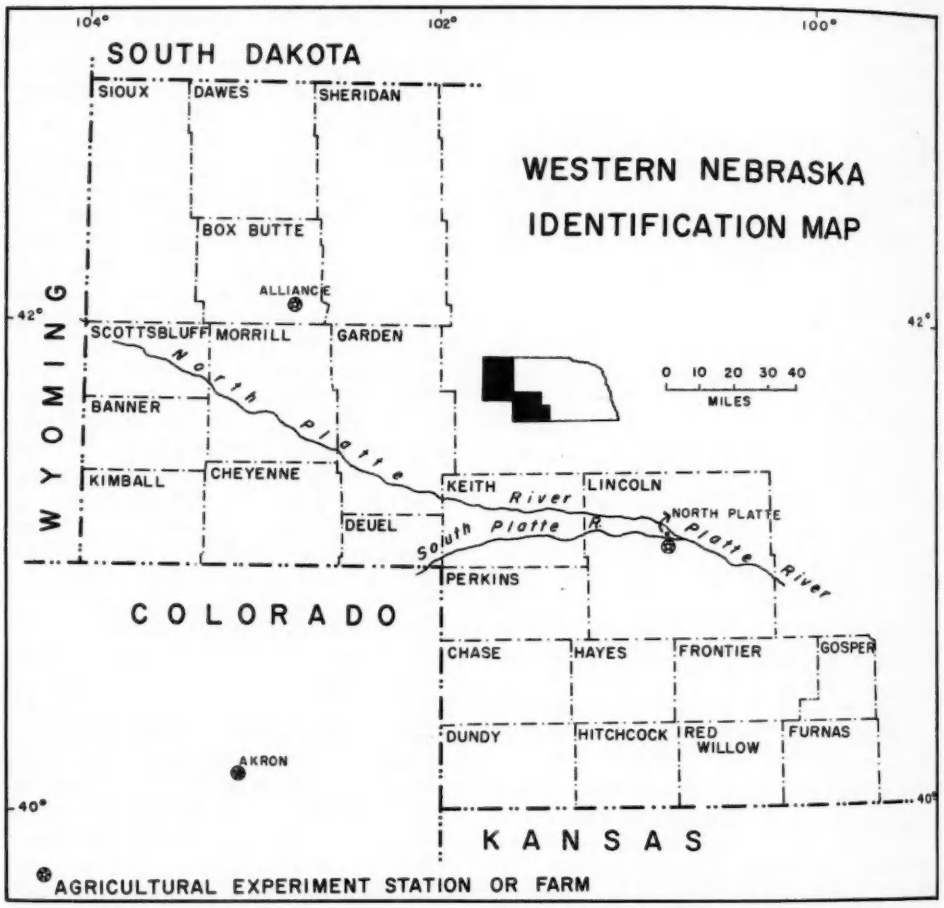

FIG. 1. The counties shown are herein defined as western Nebraska. They will be divided for some purposes into counties of the panhandle and those of the southwest. Gosper and Furnas counties although included here are not ordinarily included in the southwestern district for statistical purposes.

for the years 1931–37 than during the period 1938–54. Figure 2 shows average failure for the first period. Figure 3 represents failure of wheat for the period 1938–54 with only minor error.[5] The fact that data by practices for spring wheat are not available does not introduce an important error in the comparison, except perhaps for the three most northerly counties, because of the notable reduction in spring wheat acreages since the great drought of the 1930's. As a comparison of Figures 2 and 3 shows, wheat failure was commonly reduced by more than 50 percent, and in the majority of counties by more than 20 percentage points. As was shown in an earlier report,[6] reductions in failure were far greater in western than in eastern Nebraska. A major purpose of this paper is to identify reasons for the marked decline in wheat failure in western Nebraska.

[5] The years 1940, 1941, and 1948–54 are used because they are the only years for which records of planted and harvested acres and yields by practices (continuous-cropped and summer-fallowed) were found. In no county does the over-all average percentage of failure for these years differ notably from the over-all average for the years 1938–54.

CAUSES OF WHEAT FAILURE SINCE 1937

Only for the period of federal crop insur-

[6] Hewes and Schmieding, *op. cit.*

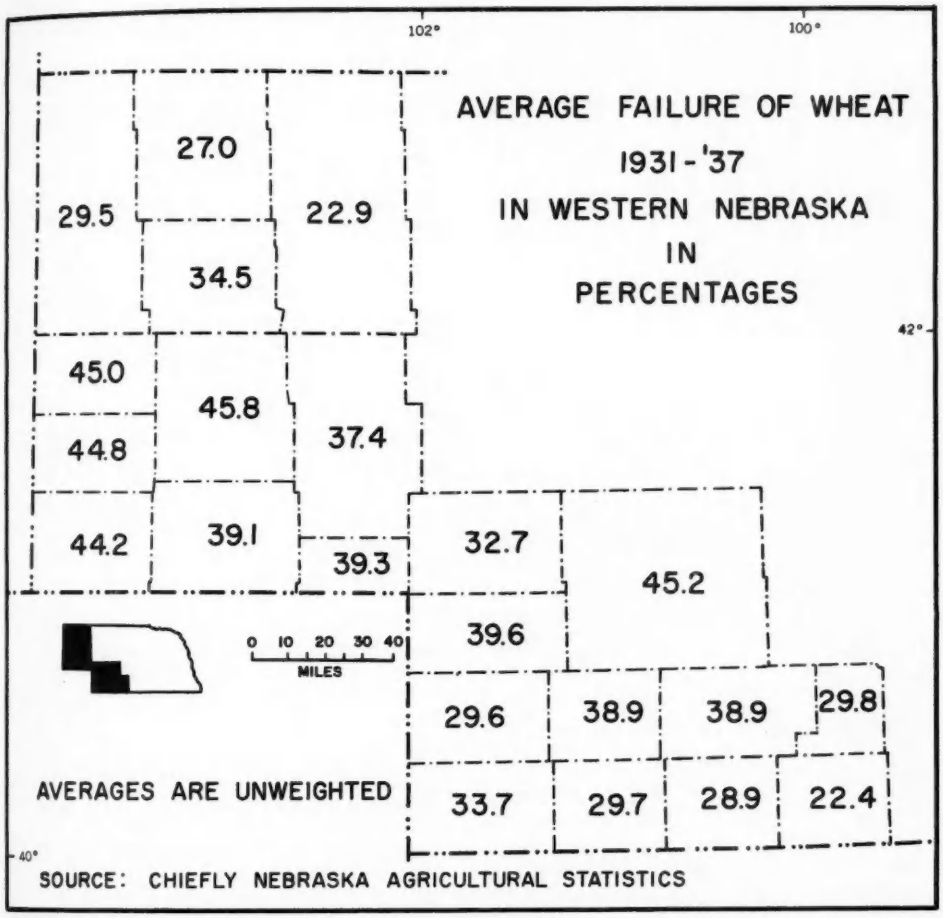

FIG. 2. Average failure of wheat in western Nebraska, 1931–37. Percentages are based on *Nebraska Agricultural Statistics* except for the unpublished data on planted acreages of spring wheat for 1932 and 1933, furnished by the Field Crops Statistical Branch, Agricultural Estimates, Agricultural Marketing Service, Washington. Winter wheat only was used for 1935.

ance, which covers most of the time since 1938, is an areally extensive set of quantitative records of causes of loss of wheat available.[7] Applicable to both this period and the earlier one are estimates of loss because of rust; loss-cost figures for commercial hail insurance; contemporary opinions expressed in newspapers, federal–state crop reports, monthly and annual climatic summaries; and records of agricultural experiment farms. Plainly, identification of causes of failure on a widespread and, therefore, readily mappable basis is much better for the latter two-thirds of the period of study.

Causes of wheat failure[8] in the state during the years of federal crop insurance were mark-

[7] These records consist of a summarization by counties of the first and second most important causes for which indemnity was paid (for failure or near failure) on the various participating farms. The number of causes reported for a county in a given year may range from one to a dozen.

[8] The weighting of causes of failure was determined in this manner: First, it was assumed that insured wheat in a given county was representative of all wheat in the county. Accordingly, the acreage of failure due to a given cause in any year was determined by multiplying the total amount of failure

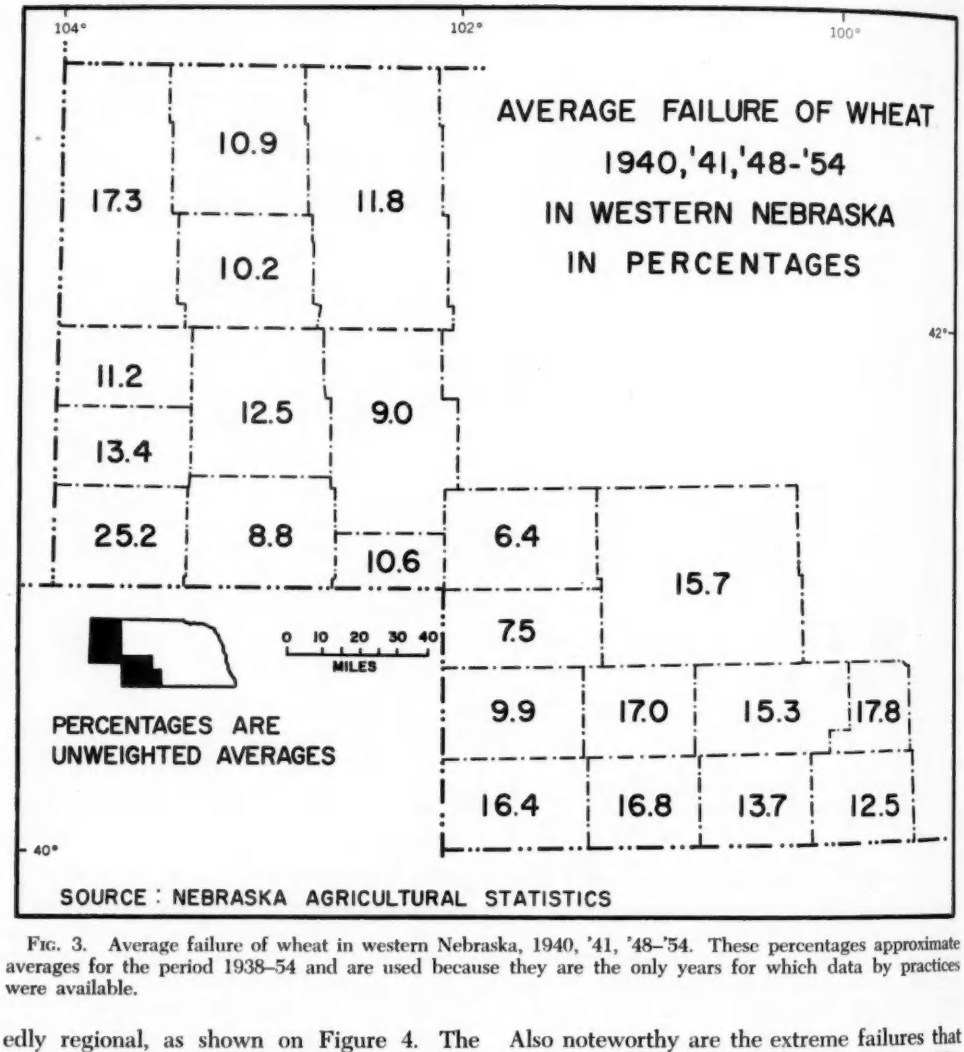

FIG. 3. Average failure of wheat in western Nebraska, 1940, '41, '48–'54. These percentages approximate averages for the period 1938–54 and are used because they are the only years for which data by practices were available.

edly regional, as shown on Figure 4. The average and extreme failures of wheat due to each of the three chief recognized causes are presented in Figures 5–10. Probably the small amount of failure due to drought in western Nebraska is the most unexpected disclosure. Also noteworthy are the extreme failures that may result from winterkilling in eastern Nebraska and the substantial damage from hail that may occur in unit areas as large as counties in westernmost Nebraska. Examples of causes of high failure not mapped in Figures 6, 8, and 10 are rust in 1944 about midway along the Kansas boundary, but mainly east of the area here called western Nebraska, disease (mosaic) in Kimball County in 1954, and wind in Hayes County in 1954.

CAUSES OF FAILURE, 1931–37

There is little doubt that drought was the outstanding cause of wheat failure for the

recorded for the county by the percentage of indemnity paid for a particular cause. Thus for all years of record the average failure due to a given cause could be computed. The results obtained are independent of the variation in amount of insurance written from year to year. In drawing boundaries, the short-term records of two counties were ignored as not being representative. Otherwise, regionalization is consistent with the data for individual counties.

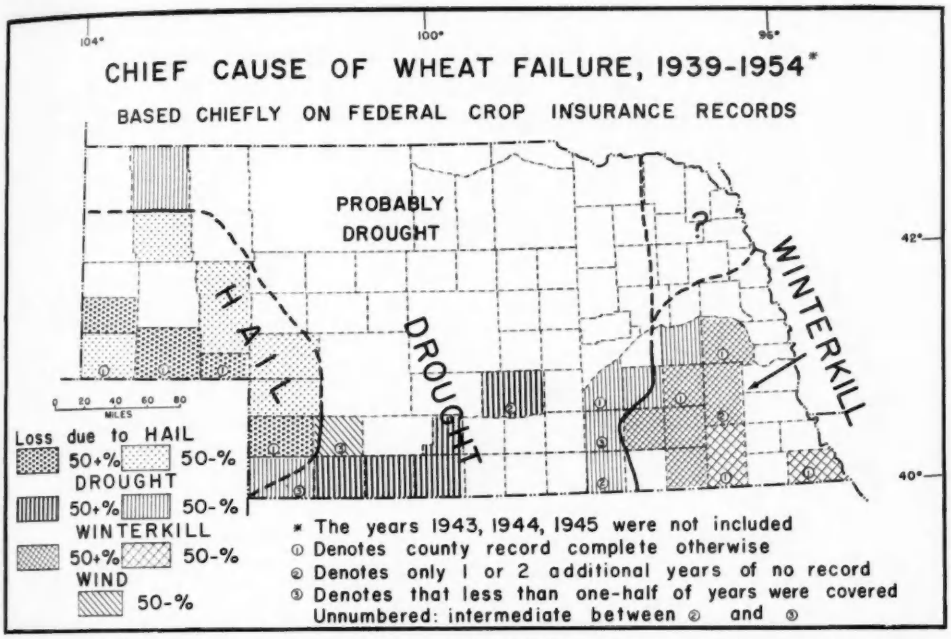

FIG. 4. Chief cause of wheat failure according to Federal Crop Insurance records, 1939–54. There was no insurance program in 1944 and 1945 and records for 1943 are not available. Number 1 indicates the most complete record, number 3 the least complete record.

period 1931–37. As a result of what amounted to a poll of farmers made in 1935, it was reported for the loam section (chief wheat growing section) of Perkins County that in nearly half of the years drought caused damage to crops. For the loam section of Perkins County and for nonirrigated farms in Goshen County, Wyoming, located just west of Scotts Bluff County, Nebraska, group opinions were reported as follows on the number of years in which damage to crops was due to the causes specified: Perkins County, drought 47, hail 21, insects 17, soil blowing 12, rust 6, frost 6; Goshen County, drought 27, soil blowing 15, hail 11, rust 6, insects 5, frost 4.[9]

If it is assumed that these two counties were fairly representative of causes of wheat failure in western Nebraska (as well as of "damage"), the chief cause was drought. Others of considerable importance were hail, grasshoppers, and soil blowing. In addition, winterkilling was an important cause of failure at least in northwestern Nebraska.

Causes of failure mentioned in the records of the Nebraska Agricultural Experiment Station emphasize drought and include winterkilling and wind damage.[10] For the Alliance Farm, located in Box Butte County, a summarization of causes of failure follows: 1931—winterkilling; 1932—winterkilling; 1934—drought; 1935—drought; 1936—winterkilling and drought; 1937—high winds and drought. Failure was complete in the years 1934 to 1937, inclusive.[11] A summarization of causes of failure at the North Platte Substation, located in Lincoln County, follows: 1932—autumn too dry; 1933—poor fall germination; 1934—dry and windy, hot summer; 1936—

[9] R. S. Kifer and H. L. Stewart, "Farming Hazards in the Drought Area," *Research Monograph XVI*, U. S. Works Progress Administration, Division of Social Research (Washington, 1938), p. 55. A few minor causes are omitted. Insects referred chiefly to grasshoppers.

[10] These records were made available through Dean W. V. Lambert, University of Nebraska, College of Agriculture. The cooperation of numerous individuals in the college and at the experiment farms was invaluable.

[11] Wheat did not fail at the Alliance farm in 1931 and 1932. However, the annual report for 1932 identifies winterkilling as the common cause of failure in the area in both years.

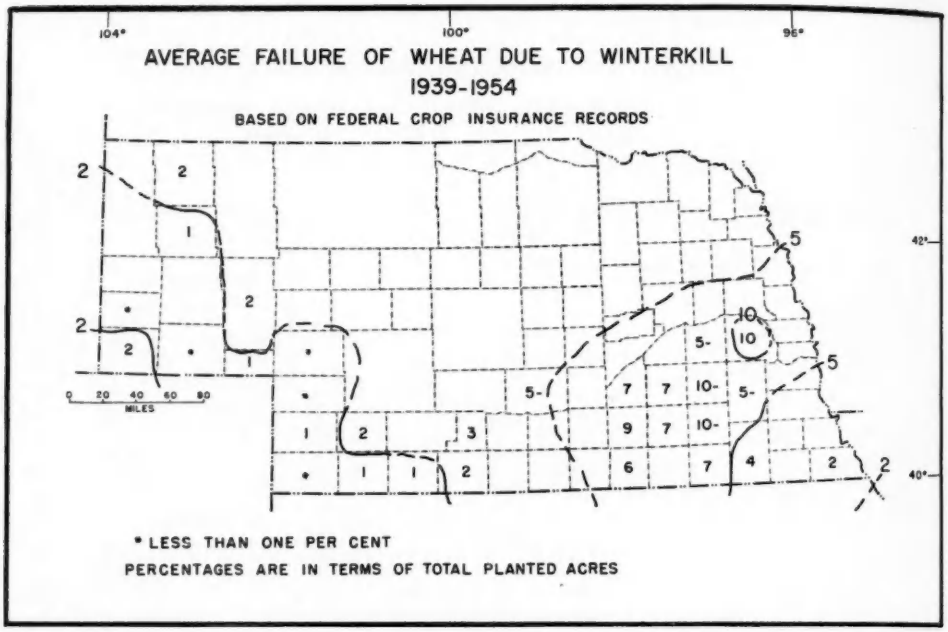

FIG. 5. Average failure of wheat due to winterkilling, 1939–54. Heaving, icing, and sharp drops of temperature combine to make winterkilling important in part of eastern Nebraska.

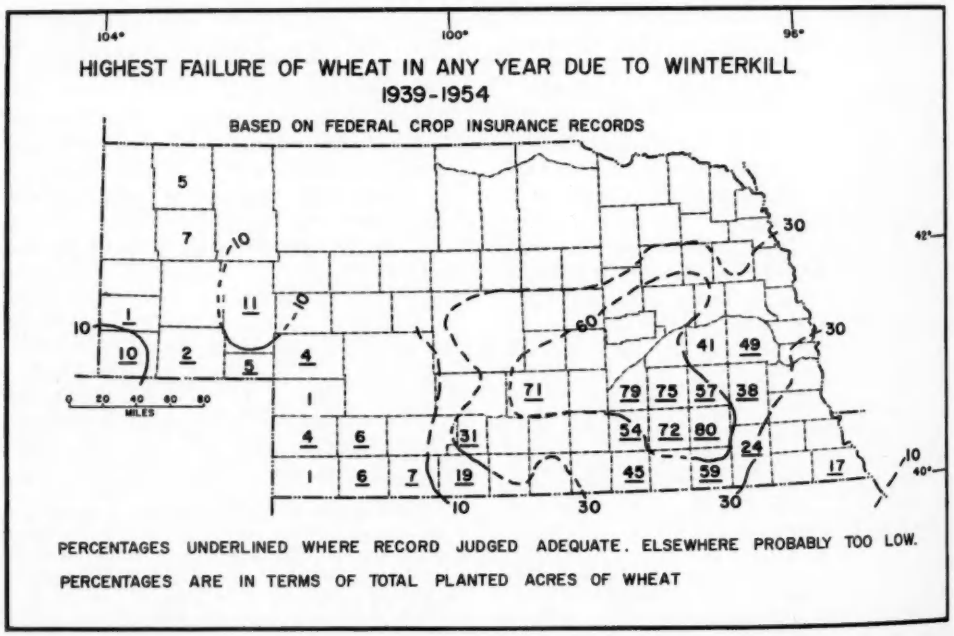
104°
100°
96°
HIGHEST FAILURE OF WHEAT IN ANY YEAR DUE TO WINTERKILL
1939-1954
BASED ON FEDERAL CROP INSURANCE RECORDS
42°
40°
0 20 40 60 80
MILES
PERCENTAGES UNDERLINED WHERE RECORD JUDGED ADEQUATE. ELSEWHERE PROBABLY TOO LOW.
PERCENTAGES ARE IN TERMS OF TOTAL PLANTED ACRES OF WHEAT

FIG. 6. Highest failure in any year due to winterkilling, 1939–54. Loss due to this cause may run extremely high in eastern Nebraska. The crop of 1941 is an example, as were those of 1917 and 1932.

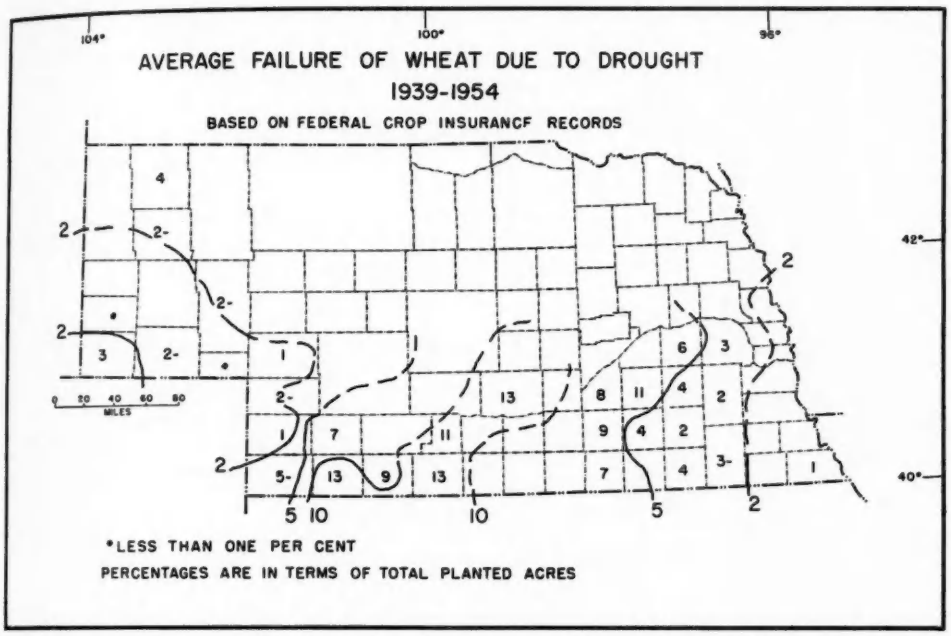

FIG. 7. Average failure of wheat due to drought, 1939–54. A belt near the semiarid margin, where much wheat was planted without fallowing, and including much rolling and sandy land, constitutes a ridge of highest average failure.

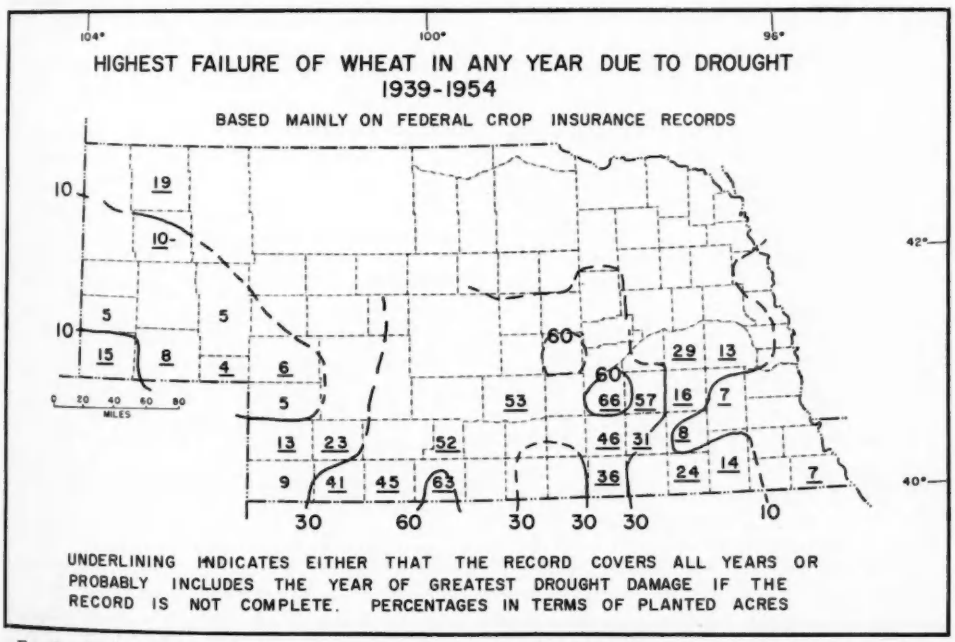
HIGHEST FAILURE OF WHEAT IN ANY YEAR DUE TO DROUGHT
1939-1954
BASED MAINLY ON FEDERAL CROP INSURANCE RECORDS
104°
100°
96°
42°
40°
0 20 40 60 80
MILES
UNDERLINING INDICATES EITHER THAT THE RECORD COVERS ALL YEARS OR PROBABLY INCLUDES THE YEAR OF GREATEST DROUGHT DAMAGE IF THE RECORD IS NOT COMPLETE. PERCENTAGES IN TERMS OF PLANTED ACRES

FIG. 8. Highest failure of wheat in any year due to drought, 1939–54. It is notable that failure due to drought was not high in either easternmost or westernmost Nebraska in any year of record.

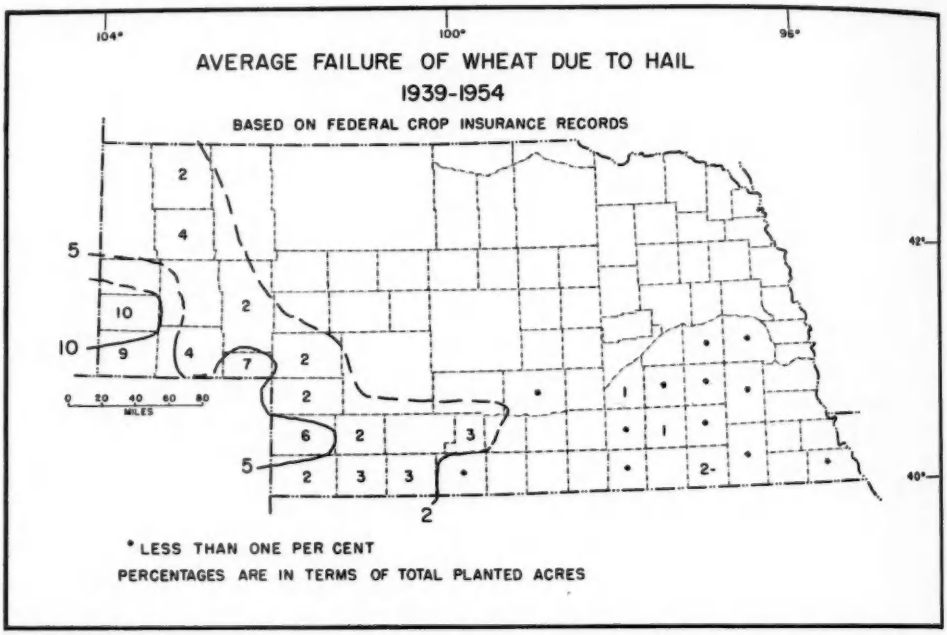

FIG. 9. Average failure due to hail, 1939–54. Loss is greatest in westernmost Nebraska.

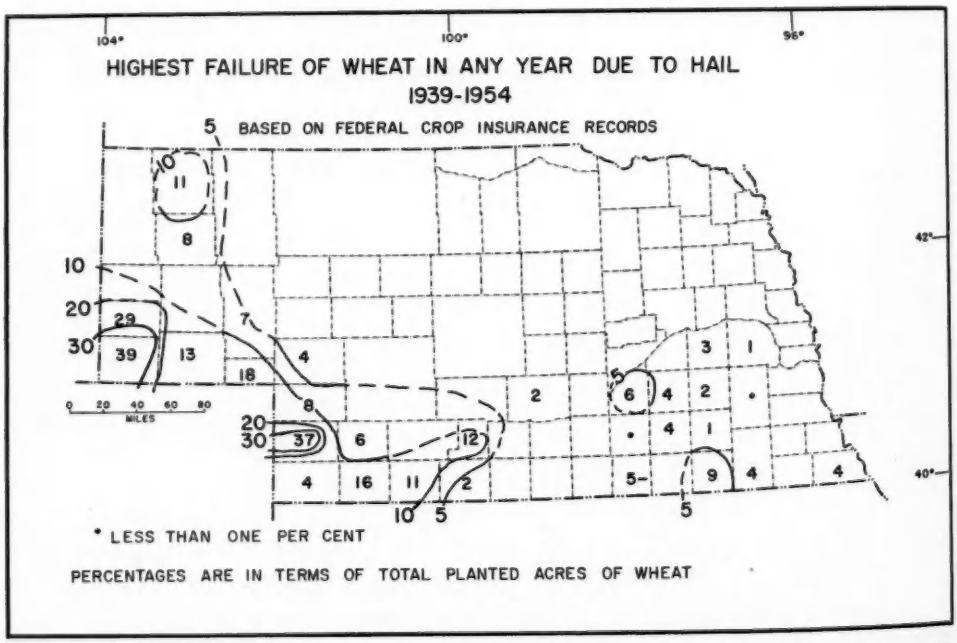

FIG. 10. Highest failure in any year due to hail, 1939–54. The patchiness of the distribution is probably due largely to the shortness of the record.

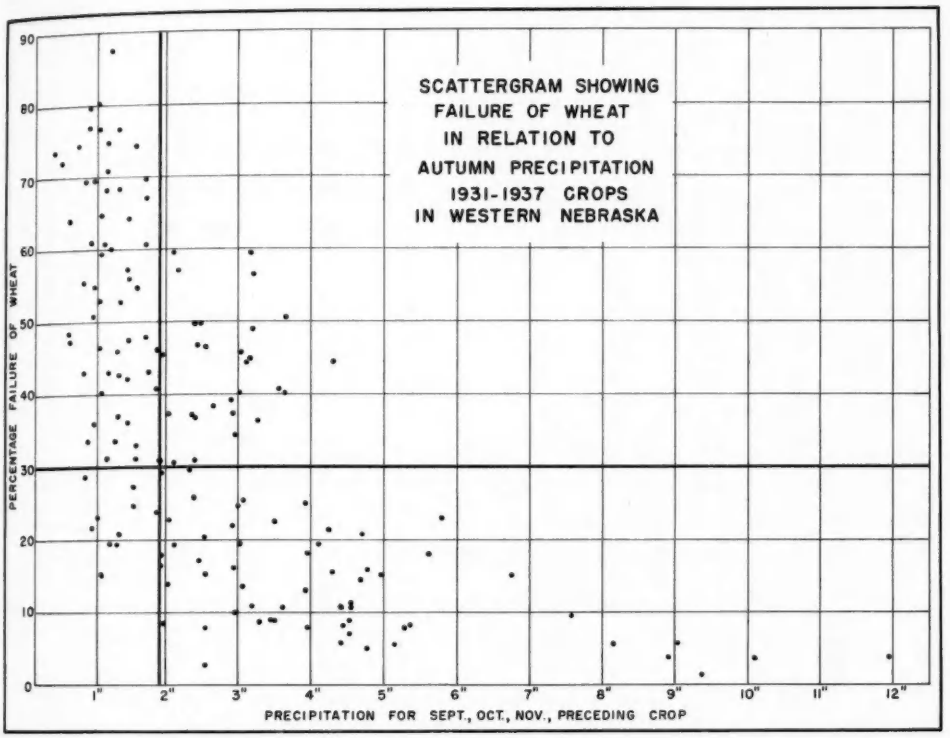

FIG. 11. Scattergram showing failure of wheat in relation to autumn precipitation, 1931–37. The lower limit of what is called "high" failure, the 30 percent line, has been emphasized; likewise the precipitation line of 1.9 inches. With less than 1.9 inches failure was usually high.

winterkilling, drought, and soil blowing; 1937 —drought, cold, or both.[12] Other contemporary records indicate that soil blowing in 1932 and 1935 was severe. In 1935, black stem rust was very damaging in the panhandle counties.[13]

An empirical test was made of various climatic conditions considered as likely to produce failure of wheat through drought. This test took the form of establishing coefficients of correlation between average failure by counties for the years 1931–37 and climatic data for weather stations, each as centrally located as possible within the county. The climatic condition showing highest correlation with failure was a dry autumn. The coefficient of correlation[14] of percentage of wheat failure with total precipitation for the preceding September, October, and November was a relatively high minus .630. Other correlations with failure were: rain of preceding September, minus .492; July to June precipitation preceding harvest, minus .482, but when the precipitation for September, October, and November was removed, the coefficient of correlation dropped to minus .256; preceding August precipitation, minus .284; preceding July and August precipitation, minus .265; December to March precipitation, inclusive, minus .175; April to June precipitation, inclusive, minus .087. A correlation involving late spring temperatures was run

[12] Causes for 1932, 1933, and 1934 were derived from L. L. Zook and H. S. Weakley, "Crop Rotation and Tillage Experiments at the North Platte [Nebraska] Substation, 1907–34," *Technical Bulletin No. 1007*, U. S. D. A., April, 1950; causes for 1936 and 1937 from annual reports of the substation.

[13] The September 1, 1935, *Comments of* [Nebraska State-Federal] *Agricultural Statistician to Accompany Report*, stated that much spring wheat was not worth harvesting due to black stem rust. *The Annual Report of Barberry Eradication, Nebraska, 1935*, p. 66, contained the estimate that 45 percent of the wheat crop in the panhandle was lost because of stem rust.

[14] Pearson product moment correlation.

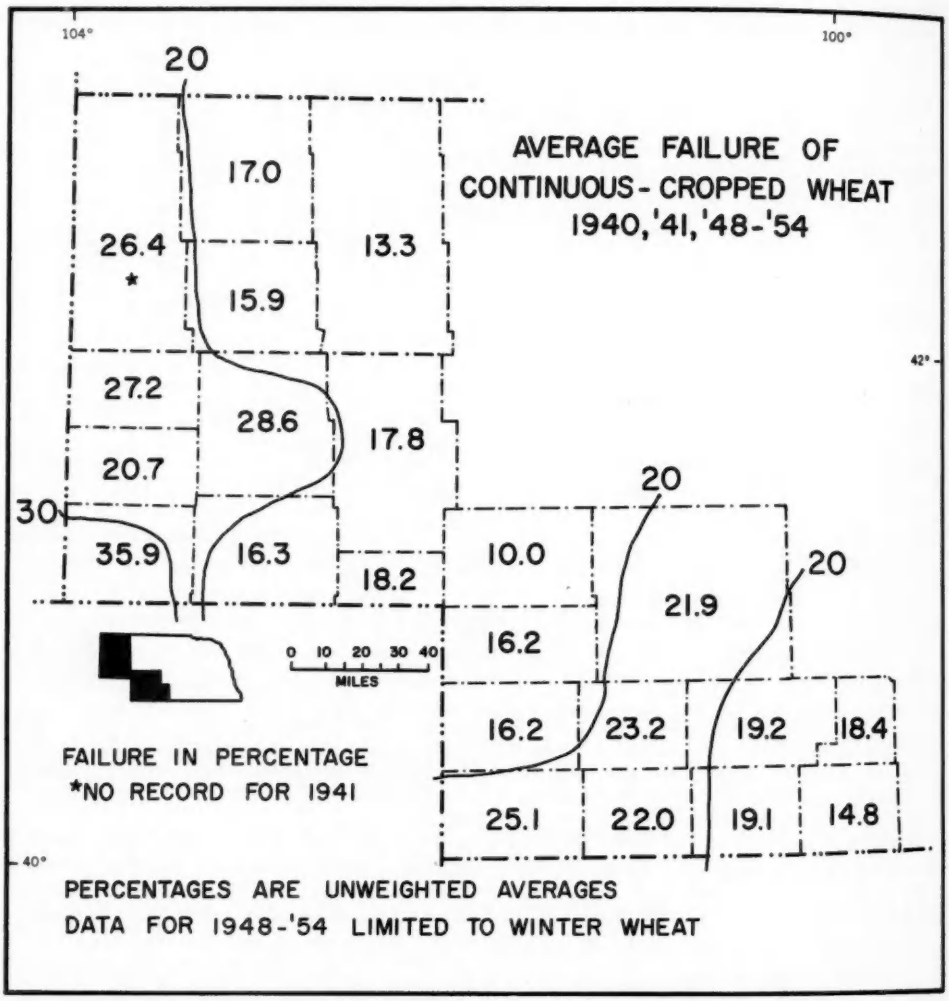

FIG. 12. Average failure of continuous-cropped wheat, 1940, '41, '48–'54. Data for 1940 and 1941 are from AAA records; for the other years from local Agricultural Marketing Service records. Note that failure was highest at the extreme west and in a "ridge" in the southwest.

only for southwestern Nebraska, where mean temperatures are about the same throughout the area. In southwestern Nebraska the correlation was plus .230 for May temperatures; minus .070 for June temperatures. All the correlations noted except that with June temperatures are in agreement with the well-established generalization that inadequate moisture is the chief limiting climatic factor in wheat production in the central Great Plains.

Figure 11 is a scattergram showing wheat failure with respect to precipitation in the three autumn months preceding harvest. It appears that in the great majority of cases an autumn precipitation of less than 1.9 inches "insured" high failure. In southwestern Nebraska, with higher temperatures, with virtually no spring wheat and with less summer fallow than in the panhandle, the critical autumn rainfall was higher.

A statistical test was made of the experi-

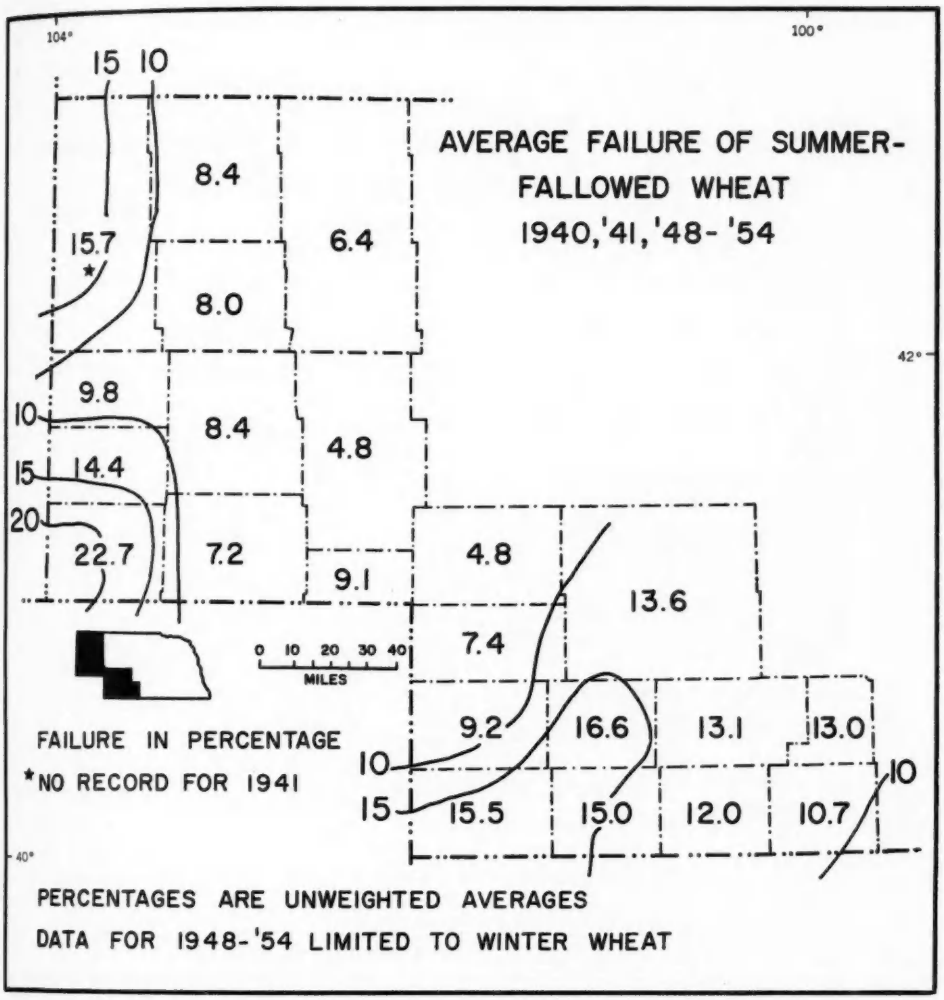

FIG. 13. Average failure of summer-fallowed wheat, 1940, '41, '48–'54.

mentally developed conclusion that on non-sandy land in a semiarid central Great Plains environment there is essentially no carry-over of available soil moisture from one crop to the next under continuous cropping of wheat.[15] Failure averaged almost as great after the first dry autumn as after a succession of dry autumns, the difference being less than 2 percentage points. Apparently, rainfall deficiency for continuous-cropped wheat is not notably cumulative from year to year, largely substantiating the conclusion that there is little carry-over of moisture from one year to another. In comparison, the average failure in a series of high failures after dry autumns not counting the first year in the series of high failures was more than 5 percentage points greater than the average for the initial years of high failure. The application to wind damage is easy to see —less stubble, more blowing. It appears that high failure regardless of cause is more likely to increase failure in the next year than is a succession of dry autumns.

[15] John S. Cole and O. R. Mathews, "Subsoil Moisture under Semiarid Conditions," *Technical Bulletin* 637, U. S. D. A., April, 1939, p. 68.

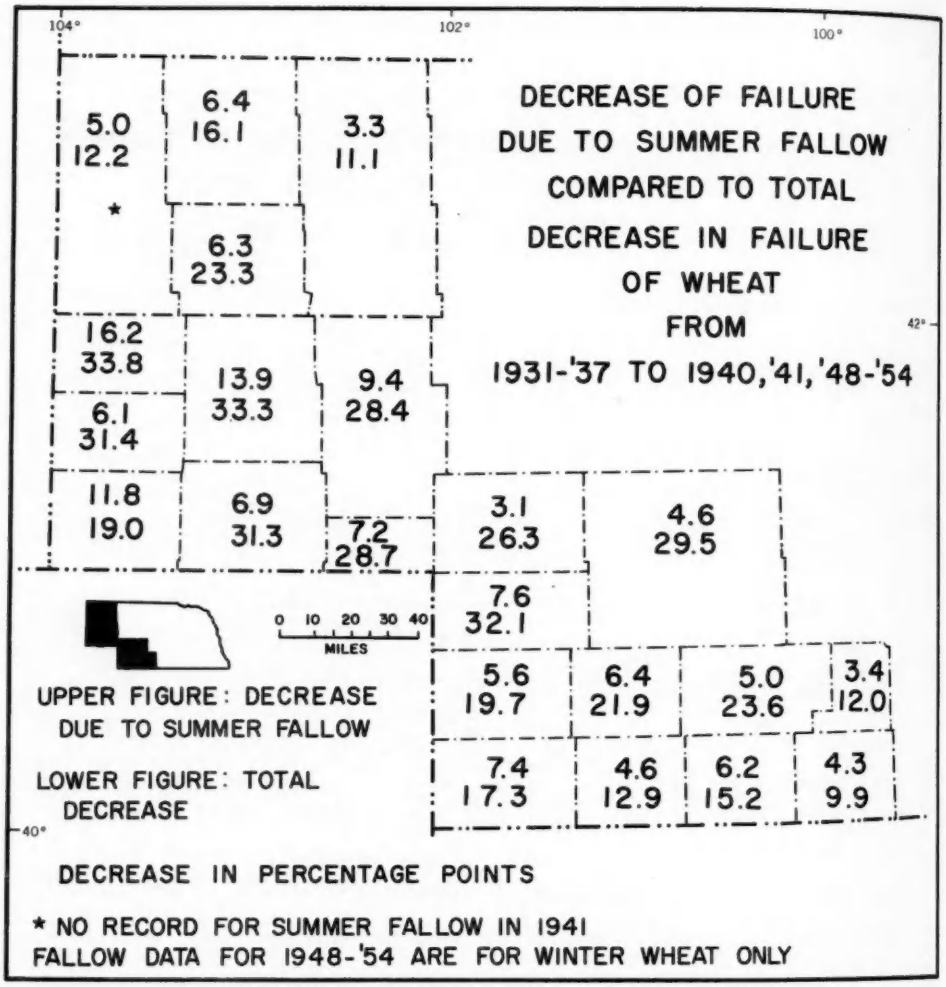

FIG. 14. Decrease in failure credited to summer fallow compared to total decrease from earlier to later period. The large decreases resulting from the use of fallow in the southern portion of the panhandle were due both to greater use of and greater effectiveness of summer fallow there.

ROLE OF SUMMER FALLOW IN REDUCING WHEAT FAILURE

Popular opinion holds the increased use of summer fallow responsible for much of the reduction of wheat failure in western Nebraska since 1937. In the small area then defined as the specialized wheat area, scarcely an eighth of the wheat was grown on summer-fallowed land in 1929.[16] It is unlikely that as much as one-half of the wheat was planted on summer fallow as late as 1937 in any county in Nebraska except in the three most southerly panhandle counties, even after the substantial increase of summer fallow spurred by drought, AAA, and soil conservation legislation. However, AAA records indicate that more than half of the 1940 crop was planted on summer fallow in most of western Nebraska other than in the northern part of the panhandle and in Lincoln County. Continuous cropping made a partial comeback in the

[16] Harold Hedges and F. F. Elliott, "Types of Farming in Nebraska," *Nebraska Agricultural Experiment Station Bulletin 244*, 1930.

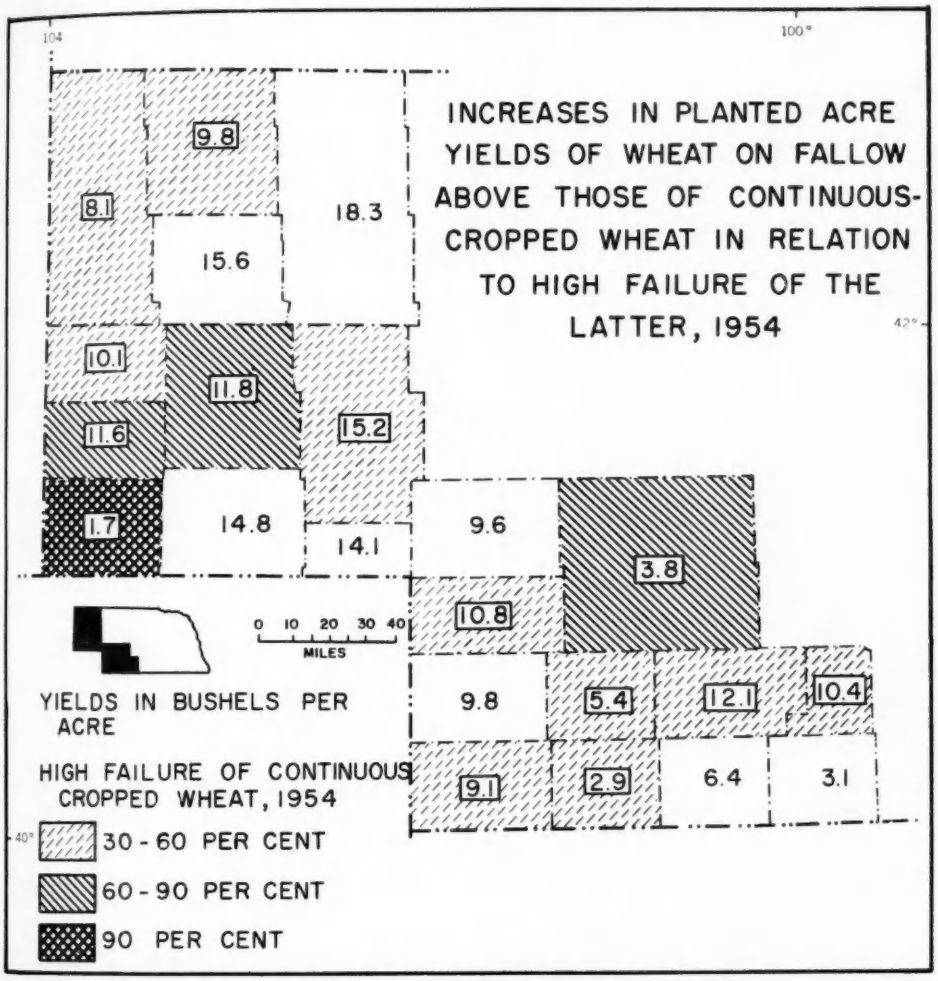

FIG. 15. Increases in planted acre yields due to summer fallow in relation to occurrence of high failure on continuous-cropped wheat, 1954. This map is a considerable rebuttal to the claim that all methods fail in a bad year.

years of World War II, but in 1954 in only one county in western Nebraska was less than 84 percent of the winter wheat summer-fallowed. The increase of summer fallow in western Nebraska since 1937 has been very large.

The effectiveness of summer fallow in increasing yields and decreasing failure can be judged both by controlled experiment and by county estimates of performance under actual farming conditions. Figures 12 and 13 show average percentages of failure under continuous cropping and summer fallowing.[17] Although yields obtained under controlled experiment are higher than county averages,

[17] An area in southwestern Nebraska shows up as a "ridge" of higher failure. The explanation is probably largely edaphic—a large amount of rolling land and somewhat sandy land. This interpretation is reinforced by a map of average failure by minor civil divisions based on assessors' estimates made in May of each year for the years 1938–47. Most precincts with above-average failures were fairly rough in terrain or sandy. Figures 12 and 13 are in agreement with Figure 3.

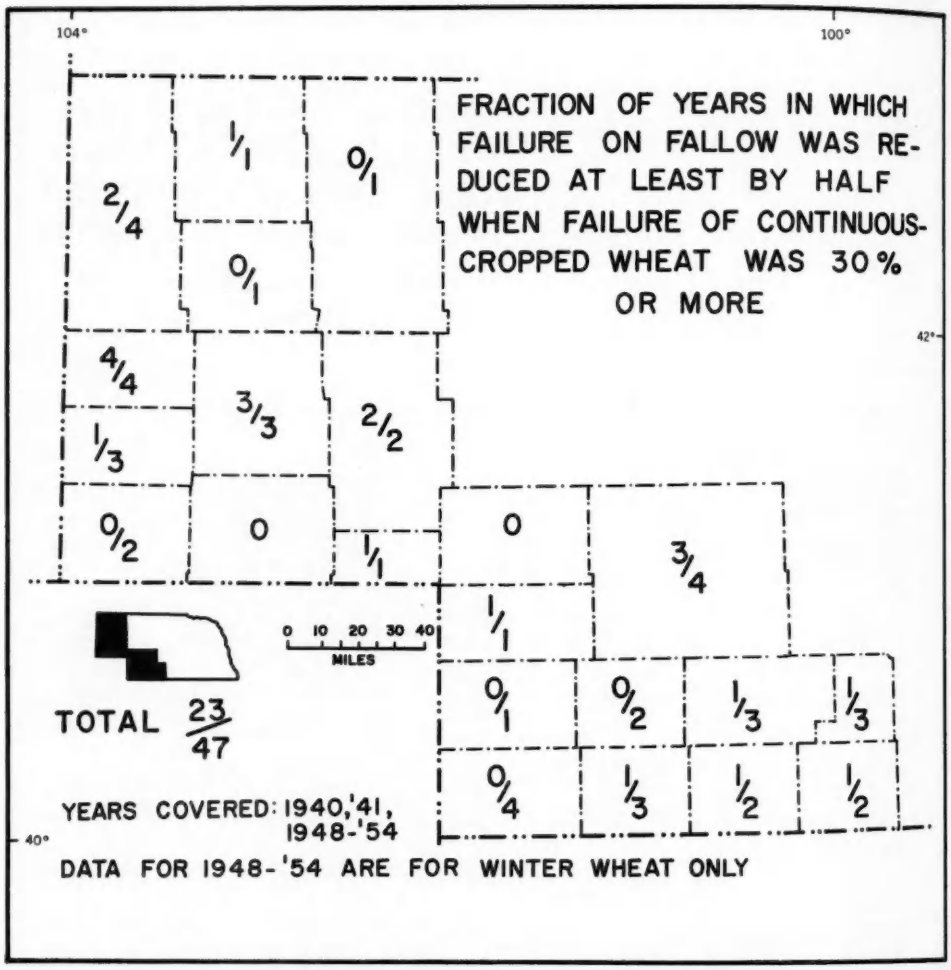

FIG. 16. Fraction of years in which failure on fallow was reduced *at least* by half when failure of continuous-cropped wheat was 30 percent or more.

the results are sufficiently consistent so that county averages can be used to test the effects on wheat failure. An average of the reduction of failure due to summer fallow can be obtained simply by multiplying the percentage of all wheat that was summer-fallowed by the difference in percentage of failure between summer-fallowed and continuous-cropped wheat for each year of record and then averaging the reduction (or increase) in percentage points of failure. Figure 14 represents the apparent reduction in failure due to the summer fallowing actually carried out. In most of western Nebraska the reduction was substantial, in three panhandle counties exceeding 10 percentage points and in one county amounting to more than one-half the total reduction accomplished from the earlier to the later period.[18]

It has been claimed that all farming methods, including summer fallow, fail in a bad

[18] There is, of course, some error involved in thinking of all wheat grown in the period 1931–37 as being continuous-cropped. Probably the error is substantial only in the three most southerly counties of the panhandle.

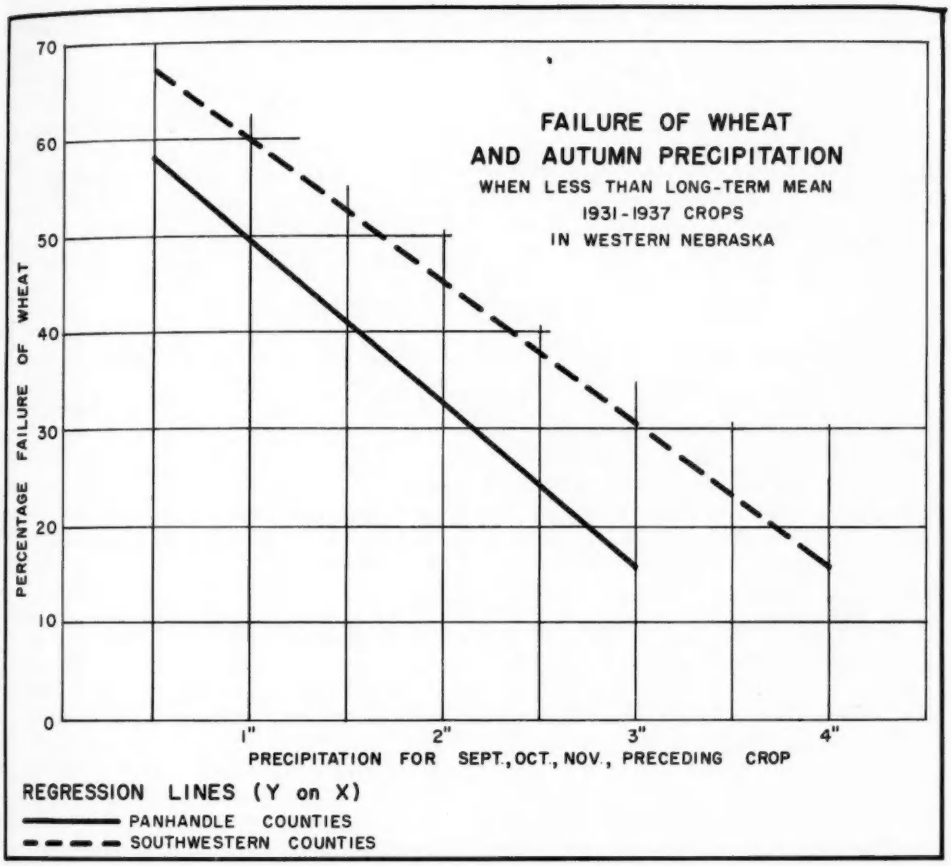

FIG. 17. Regression lines of failure of wheat and autumn precipitation, 1931–37, when autumn precipitation was less than the long-term mean.

year. In 1931, Chilcott in a government publication damned summer fallow with these words, "It is at best a slight reduction of the hazard."[19] Even then his appraisal was too pessimistic. The year 1954 should be a fair test as it was the worst recent year of wheat failure and occurred after experience had been gained in summer fallowing throughout western Nebraska. Figure 15 shows that there was a substantial advantage for summer-fallowed wheat in 10 of the 14 counties in which the failure of continuous-cropped wheat was as high as 30 percent. Fallowing helped little in three counties in southwestern Nebraska which suffered heavy losses from wind and in one county in the panhandle which underwent heavy loss through the combination of wheat mosaic, hail, winterkilling, drought, and wind. Figure 16, covering all years of record for the period under study, shows that when failure under continuous cropping was as high as 30 percent, summer-fallowed wheat had failures no more than one-half as great in 23 of 47 cases. The record shows that even in bad years, failure is often reduced markedly by summer fallow.

[19] E. C. Chilcott, "Relation between Crop Yields and Precipitation in the Great Plains Area," Supplement 1, "Crop Rotation and Tillage Methods," *Miscellaneous Circular 81*, U. S. D. A., 1931, p. 28.

MORE ADEQUATE AUTUMN PRECIPITATION

A comparison of figures 2 and 12 indicates that wheat failure under continuous cropping was notably less in the later period than in

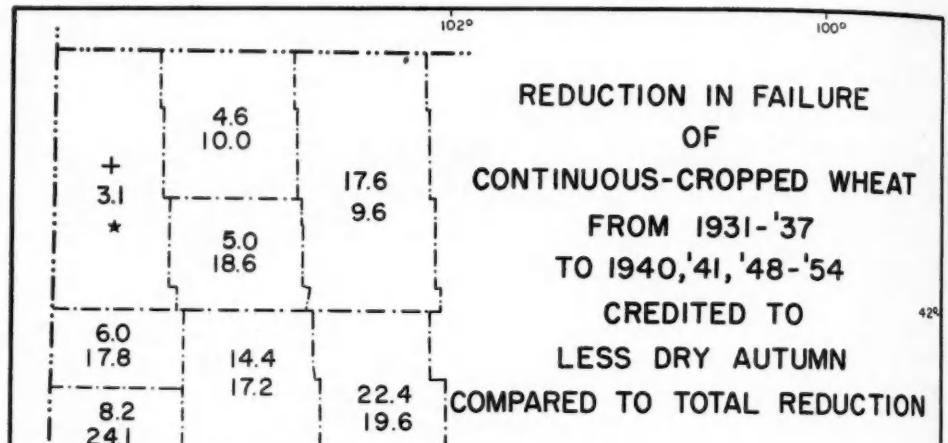

FIG. 18. Reduction of failure of continuous-cropped wheat from earlier to later period credited to less dry autumn compared to total reduction of failure. The regression lines of Figure 17 were used in estimating effects of less dry autumns. Note that in eight counties deficits of autumn precipitation were *greater*, not smaller, in the second period. Data for 1948–54 are for winter wheat only.

the years 1931–37. Other factors than fallowing must be sought, for this improvement is independent of summer fallowing.

Autumn rainfall has been identified previously as the climatic factor most likely to be of critical importance. Proceeding on the commonly accepted assumption that with average precipitation there would be little drought problem in the Great Plains, a comparison of the incidence of less than average autumn precipitation between the earlier and later periods of this study should be an important measure of improvement or deterioration of climate. For convenience, the values of three inches in the panhandle and four inches in southwestern Nebraska, which are approximately medians of the actual long-term means, were used as means. Regression lines (y on x) were drawn for each of the two groups of counties to represent the relation between less than average autumn rainfall and percentage of failure for the crop years 1931–37 (Figure 17). A decrease of one inch below average autumn precipitation was accompanied by an

average increase in failure of 16.8 percentage points in the panhandle counties; of 14.57 percentage points in the southwestern counties. Thus, rough yardsticks were provided for measuring the expected effects of changes in the average deficit of autumn precipitation from the earlier to the later period.

On this basis, a very considerable reduction in the failure of continuous-cropped wheat could be expected in much of western Nebraska, especially in the eastern part of the panhandle. On the other hand, on this same basis an increase in failure should have occurred along the Kansas boundary. Figure 18 shows a county by county comparison of the decrease in failure of continuous-cropped wheat "predicted" on the basis of comparative deficit in autumn precipitation and the reduction actually recorded. In three counties, differences in autumn precipitation were more than adequate to account for the entire decrease in failure of continuous-cropped wheat. In three others such differences accounted for more than one-half of the decrease.

If it is assumed that the reduction of failure under continuous cropping applies equally to fallowed wheat and if the saving credited to improved autumn precipitation is added to the saving credited to summer fallow, the total obtained—the reduction due to the two favorable factors—is greater than the actual reduction in the three counties of Sheridan, Garden, and Kimball. This result suggests that the favorable effects of improved autumn precipitation have been exaggerated, although it is theoretically possible that increased damage due to other factors (such as hail and disease) may have had a counterbalancing effect. In fact, this was probably true in Kimball County. However, the procedure of adding benefits calculated as due to improved autumn precipitation to those credited to fallow leaves over one-half of the reduction in failure unaccounted for in 12 of the 22 counties. Clearly, other factors than summer fallow and improved autumn precipitation have played important roles in the reduction of wheat failure.

OTHER FACTORS

Identification of most factors other than summer fallow and more nearly adequate autumn moisture which may have contributed to the reduction of wheat failure is less certain and the quantitative estimation of their effects hazardous. Nevertheless, some plausible deductions can be made as to the contributions of some other factors.

In the first place, there is substantial evidence that a dry autumn was less damaging in the period after the autumn of 1936 than before. The correlation between autumn precipitation with failure of continuous-cropped wheat, which had been a high minus .630, declined to minus .410 for the crop years 1940, 1941, 1948–54. Similarly, the correlation for July–June precipitation and failure declined from minus .482 to minus .235; that for September precipitation and failure declined from minus .492 to minus .404; that for August precipitation from minus .284 to plus .029. This evidence is consistent in showing decreasing correspondence between wheat failure and precipitation. Especially significant is the fact that whereas in the earlier period autumn precipitation of less than 1.9 inches "predicted" failure of 30 percent or more in 56 of 66 cases (Figure 11), for the latter period comparable figures were only 25 failures in 49 cases. It seems obvious that precipitation now "goes farther."

Possible reasons why precipitation has become or at least seems more effective in the later than in the earlier period include several that question the comparability of the statistics. There seems reason for thinking that there was no intention of harvesting all planted wheat in some earlier years. In the fall of 1934, farmers were permitted to plant as much wheat as they wished in order to prevent blowing despite the acreage control program of the AAA.[20] Also, from a nearby section of Colorado (Weld County) farmers complained that it was too dry to plant the *minimum* acreage required by the government's AAA program.[21] In both cases, plow-up of wheat, and, by definition wheat failure, was increased.

It is reasonable to assume that failure of continuous-cropped wheat, especially, has been reduced through increased awareness of farmers that planting in dry soil is a big gamble. Some long-time students of wheat production consider this a major cause of reduction of wheat failure.

[20] *Western Nebraska Observer* (Kimball), September 6, 1934.

[21] *Ibid.*, February 14, 1935.

A smaller number of consecutive occurrences of high failure was recorded in the later period than in the earlier. The change can be considered a cause of reduced failure, since for the period 1931–37 the second to sixth consecutive high failure averaged considerably more severe than the first year of high failure, as pointed out in the section on causes of failure, 1931–37. Applying the same discredit for successive failures to the later period results in an average reduction in failure of about three percentage points in both Banner and Kimball counties from 1931–37 to the later period. Elsewhere, the reduction would have been less. The factor of cumulative high failure appears to be of minor importance, although contributing to reduction in failure in the later period.

Grasshoppers were long a scourge of the plains farmer, especially in many dry years. From 6.5 to 10 percent of planted wheat failed because of grasshoppers in nine of the 15 counties in western Nebraska which had crop insurance in 1939.[22] In only one county since that date has the proportion reached one percent in any year for which federal crop insurance records are available.[23] Although grasshoppers have been the cause of but little wheat failure since 1939, they constituted a large hazard during the period 1931–37. If, as seems probable, 1939 was fairly representative of grasshopper damage in the earlier period,[24] the control of this pest since 1939 has been a fairly important reason for reduction of wheat failure in western Nebraska.

It seems likely that reduced loss because of disease is another, although probably minor, cause of reduction of failure. Crop insurance records show no year of high loss due to rust, and the considerable loss in 1944, not a year of crop insurance, occurred mainly farther east than western Nebraska. There was no year equalling 1935. In Kimball County wheat mosaic was an important cause of failure in 1954.[25]

Hail and wind are major causes of loss of the wheat crop in western Nebraska. For hail, information for a quantitative comparison between the two periods of study is at hand in the loss–liability ratio data of commercial hail insurance companies.[26] Although in the earlier period there were a number of counties in which there was no record of hail insurance in some years and the coverage was generally less than in the later period, the record is quite consistent that hail as a cause of loss of the wheat crop increased from 1931–37 to 1938–54. In most cases the increase was substantial. In only one county of the 22 did the loss–liability ratio decline.[27] Quite clearly, reduced hail damage has *not* been a cause of reduction in wheat failure since 1931–37; instead, loss caused by hail has increased since 1937.

Wind was considered a leading factor in wheat failure in the period 1931–37. In 1932, for example, the following doleful report came from the state's most important wheat county (Cheyenne): "Growers blame drought, high March winds, and a generally adverse winter growing season . . . and they predict the passing of winter wheat as the major crop in western Nebraska."[28] Quoting George E. Condra, pioneer conservationist and State Geologist, the same source reported in 1935: "Reports indicate many fields of winter wheat in the panhandle region were 'blown out'. . ."[29] There is abundant evidence that wind damage was formerly an important cause of wheat failure.

[22] Assuming that causes for which indemnity was paid on federal crop insurance may be applied to acres of all failed wheat.

[23] Kimball County, 4 percent in 1953, and 5 percent in 1954.

[24] This conclusion is in harmony with an "Analysis of 100 Years of Grasshopper Populations in Kansas (1854 to 1954)" by Roger C. Smith, *Transactions*, Kansas Academy of Science, Vol. 51, No. 4 (December, 1954), although damage to wheat in 1944 is indicated.

[25] Considering that payment of indemnity on federal crop insurance is indicative of failure, 34 percent of the wheat planted in Kimball County failed because of disease. For an account of how the heavy hail damage of 1953 favored the disease, see Robert I. Staples and Chester I. Walters, "Wheat Streak Mosaic," *Nebraska Experiment Station Quarterly*, Spring, 1955, pp. 10–11. This is an example of failure being cumulative.

[26] Raw data furnished by the Crop–Hail Insurance Actuarial Association, Chicago.

[27] In Lincoln County the unweighted loss to liability percentage declined from 7.66 to 6.06. Hail loss averaged greatest in the southern part of the panhandle. There, in Deuel and Cheyenne counties, it increased from 2.16 to 14.72 percent, and from 3.12 to 11.84 percent, respectively.

[28] Under Sidney date line, *Western Nebraska Observer*, June 30, 1932.

[29] *Ibid.*, March 7, 1935.

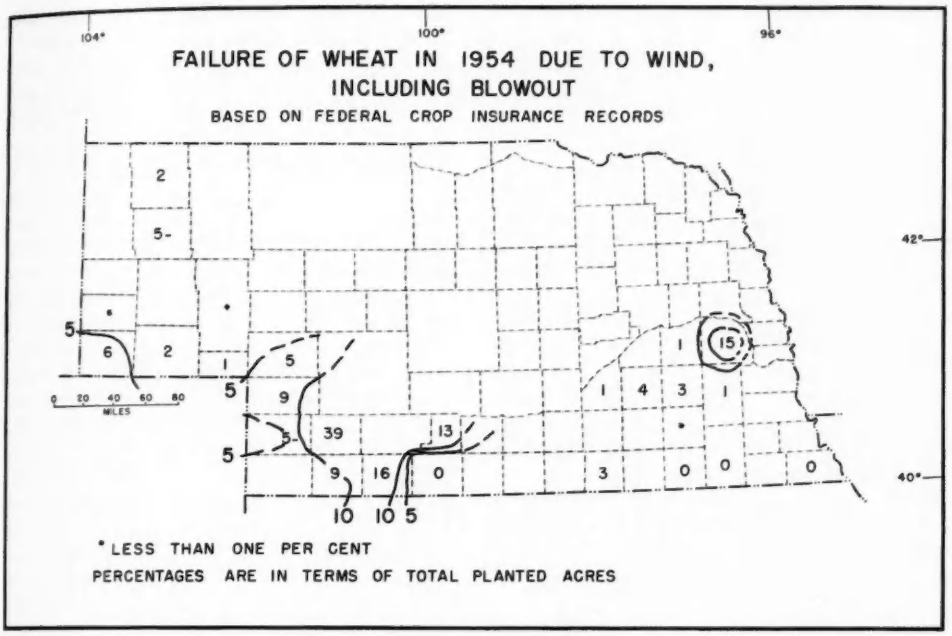

FIG. 19. Failure of wheat in 1954 due to wind.

In the years of federal crop insurance records, 1954 was the only year in which failure due to wind was as great as five percent of the planted wheat in any county. Figure 19 shows the percentages of planted wheat for which wind was the cause given for failure or near failure. These are percentages probably common in the earlier period, but it is notable that the worst damage in 1954 was not in the panhandle.

The regionalization of severe wind damage in 1954 may permit some inferences as to conditions favorable to the damage. Among these are: (1) The period December to April had been dry in the area of worst damage—Hayes, Red Willow, Lincoln, and Frontier counties each received less than 1.5 inches of precipitation. (2) This is a region with much thin, sloping land and, in part, sandy land. (3) Failure in 1953 had been fairly high (Hitchcock, 26 percent; Dundy, 25; Lincoln, 19; Red Willow, 18; Gosper, 18). (4) Relatively little crop land was arranged in strips more or less at right angles to the wind. (5) There was little use of anything approaching a full stubble mulch on wheat land (leaving stubble on surface by use of subtillage). (6) The acreage in corn and grain sorghum stubble was large. These conditions individually or collectively could be expected to accentuate damage by wind or at least not interfere seriously with it.

With respect to the fact that wind damage was less in the panhandle, where in earlier years it had been severe, it should be noted that in addition to a somewhat less dry winter in 1953–54 than in southwestern Nebraska, far greater use is made of stubble mulch—notably in Scotts Bluff, Deuel, Banner, Morrill, and Kimball counties (as well as in Keith and Perkins counties in the southwestern area), and that strip-cropping "across" the wind (chiefly alternating fallow and wheat) is the rule on most of the wheat land of Banner and Scotts Bluff counties and is fairly common in Kimball County and northern parts of the panhandle.

A comparison of statistics on the use of strip-cropping and of field observations with aerial photographs made in or about 1939 shows marked resemblance in the distribution of strip-cropping in western Nebraska then

and now.[30] Although the strips are wider than recommended by conservationists, there seems good reason to credit strip-cropping with a major part of the reduction of damage to the wheat crop from wind in the western and northern parts of the panhandle.

Strip-cropping in western Nebraska is used mainly in connection with fallow. Stubble mulch, however, can be used either for fallow or continuous cropping. A stubble mulch consists of stubble left standing or otherwise exposed on the surface. A complete stubble mulch involves the use of subtillage but in most cases only a small part of the stubble is left on the surface. The use of stubble mulch by many farmers in western Nebraska, even on a partial or modified basis in the early 1940's following by a few years the nearly complete abandonment of the practice of burning stubble, may be assumed to have reduced wind damage to land and to wheat. The first official map showing the distribution of the use of stubble mulch shows that by 1946 the practice was fairly common in the western and northern part of the panhandle and in much of southwestern Nebraska.[31]

Perhaps this is the place to assess the contribution of several cultural practices to the reduction of wheat failure. A number of practices have aided in the reduction of the hazard of damage to wheat and to soil through blowing. Among these are stubble-mulching, delaying the first "plowing" until spring, reducing the number of times summer fallow is tilled, elimination of the spike tooth harrow and otherwise preventing pulverizing of the soil, and use of the lister or other implements for emergency tillage. An authoritative judgment considers stubble mulch to have been of "great value as a safety factor in the Great Plains" by making summer fallow more stable and permitting the extension of its area of use through reduction of the hazard of blowing, but without important increases in yields over those obtained through other practices.[32]

The deep-furrow drill is apparently used much more commonly now in the panhandle, especially when the surface soil is dry, than in the earlier period. Its use in Colorado was recommended in 1933 as well designed to reach moisture for germination of wheat, for holding snow, and for prevention of soil drifting.[33] In Kimball County, however, use of the deep-furrow drill at the Archer, Wyoming, Experiment Farm at that time was considered an innovation.[34] Only eight deep-furrow or "furrow" drills were listed in 64 auctions or public sales of farm machinery in the same newspaper in the years 1932–37. From the Akron, Colorado, station not far from the Nebraska panhandle, experimental results suggest that use of the deep-furrow drill did reduce wheat failure in the worst years.[35] In all three of the worst years reported at Akron, it is conceivable that the farmer might have considered the wheat sown with deep-furrow drill worth harvesting, and that sown with the ordinary drill not. At the Alliance Experiment Farm, located in the northern part of the panhandle, damage was less severe in 1951, after a winter of rather heavy winterkilling, where the deep-furrow drill had been used.[36] Probably the use of the deep-furrow drill, both with and without fallow, has reduced failure, particularly from winterkilling, in the panhandle.

A considerable reduction in winterkilling has taken place in northwestern Nebraska

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[30] The evidence is that the practice became common there as late as 1937 after it had been introduced into the northern plains of the United States from Canada. *Agricultural Conservation Program Maps*, U. S. D. A., PMA, for 1944, 1945, 1946, 1947, 1951, and 1953 are remarkably consistent although the last two years show considerable increase in the southwestern part of the panhandle.

[31] "Crop Residue Management under the 1946 Agricultural Conservation Program" (Map), U. S. D. A., PMA, *Agricultural Conservation Program Maps*, 1946 (Washington, 1948), p. 21.

[32] S. C. Salmon, O. R. Mathews, and R. W. Lenkel, "A Half Century of Wheat Improvement in the United States," *Advances in Agronomy*, Vol. 5 (1953), pp. 41, 42.

[33] D. W. Robertson, Alvin Kozer, J. F. Brandon, and J. J. Curtis, "Wheat Production in Colorado, 1926–32," *Colorado Agricultural Experiment Station Bulletin 404*, 1933, p. 7. However, on very sandy land there was the risk of covering of the young wheat by drifting.

[34] *Western Nebraska Observer*, March 10, 1932.

[35] For the years 1928–38, the lowest yields were obtained in 1932, 1933, and 1934, when those recorded for sowing with deep-furrow and ordinary drill, respectively, were: 1932, 2.1 and .5 bushels per acre; 1933, 5.6 and 3.5 bushels; 1934, 3.1 and 1.7 bushels. J. F. Brandon and C. R. Mathews, "Dry Land Rotation and Tillage Experiments at the Akron [Colorado] Field Station," *Circular 700*, U. S. D. A., May, 1944, p. 22.

[36] *Annual Report Cereal Investigations* (Nebraska), *1951*.

since 1931–37. Figure 6 indicates that winterkilling has not been very important as a cause of failure there in any year of federal crop insurance record. Probably the increased storage of soil moisture through the use of summer fallow in permitting winter wheat to get well established in the autumn is the main cause of reduction of loss through winterkilling. The shift to especially hardy varieties probably contributed, as indicated below, as well as the use of the deep-furrow drill.

Directly involved in making precipitation go farther is the reduction of runoff resulting from planting across the slope. This is probably a matter of major importance where the practice is common.[37] Little use was made of contouring before the late 1930's. For 1938, it was reported by the Soil Conservation Service that in the state, "Work done on the largest acreages included contour farming . . ."[38] and the Kimball paper made specific reference to the newness of the practice.[39] In southwestern Nebraska, where summer fallow has been less common than farther west and in much of which critical autumn rainfall deficiencies increased since 1931–37, it may well be that farming on the contour has been the chief cause of reduction in wheat failure in some recent years.

Another possible factor is a change in varieties of wheat grown. It is hard to believe that varieties have as unimportant a role in wheat failure as results from the experiment farms in the region indicate.[40] The record is, substantially, that if any commonly grown variety fails, all common varieties fail. At the North Platte farm, all varieties in varietal tests not fallowed failed in 1932, 1933, 1934, 1937, 1940, 1943, and 1945. At the Alliance farm, all varieties were reported as failing in replicated plot varietal tests under continuous cropping in 1934, 1935, 1936, 1937, 1940, 1941, and 1944. (Apparently, varietal testing under continuous cropping ended in 1951.) These are amazing records even if it is admitted that "failure" for experimental purposes and "failure" on ordinary farms may have different meanings! As far as the available records from experiment farms in the region indicate, there seems to have been a significant difference in failure by variety at Alliance only in 1932 and 1951, both years of severe winterkilling, and at North Platte only in 1944. At Alliance, in 1932, the range in yield was from 9.7 bushels for *Nebraska 60* to 4.0 bushels for *Blackhull*; in 1951, from 13.6 bushels for *Cheyenne* to 2.3 bushels for *Pawnee*. In these years, the differences were primarily a measure of winter hardiness. In 1944, at North Platte, *Nebred* yielded 8.7 bushels and all other important varieties 4.0 to 4.3 bushels. This was a year of autumn drought and early summer stem rust.

In the early part of the period of study, the dominant variety, or perhaps type, was *Turkey Red*. Others important in western Nebraska were *Nebraska 60* and *Kanred*. By the middle of the period of study all three had declined, all but *Turkey* to minor importance in western Nebraska. These wheats were replaced chiefly by *Cheyenne* and *Nebred*. *Cheyenne* and *Turkey* (at Alliance, *Kharkof*) were included in varietal tests throughout the period of study except for *Kharkof* in 1936 at Alliance; *Nebraska 60* was included at both places until the late 1940's, and *Nebred* has been tested since 1938 at both experiment farms. Thus, with the exception of *Kanred*, the leading varieties grown during the period of this study were tested experimentally for a considerable number of years. It appears that the change in varieties has had little influence on the reduction in failure in view of the experimental data cited, which show varieties to have been significant in three years of failure or near failure but not significant in 14 instances, totaling results from Alliance and North Platte.

Of course, in a variety as diverse as *Turkey*, and in the main far removed from the plant breeder, it is possible that the high quality *North Platte Turkey* (C I number 12143) used in experiments at North Platte was not representative of what farmers of western Nebraska were growing as their chief variety of wheat from about 1900 to past 1940. However, it seems safe to say that change in varieties grown played only a minor role in the reduction of wheat failure after 1937.

Experience is another factor. Although the great drought and crop failures of the early

[37] Agricultural Conservation Program maps show the practice was common in part of southwestern Nebraska in 1946 and 1951 but not in 1947 and 1953.

[38] *Western Nebraska Observer*, January 5, 1939.

[39] *Ibid.*, September 7, 1939.

[40] This section summarizes results of varietal tests, available in University of Nebraska College of Agriculture.

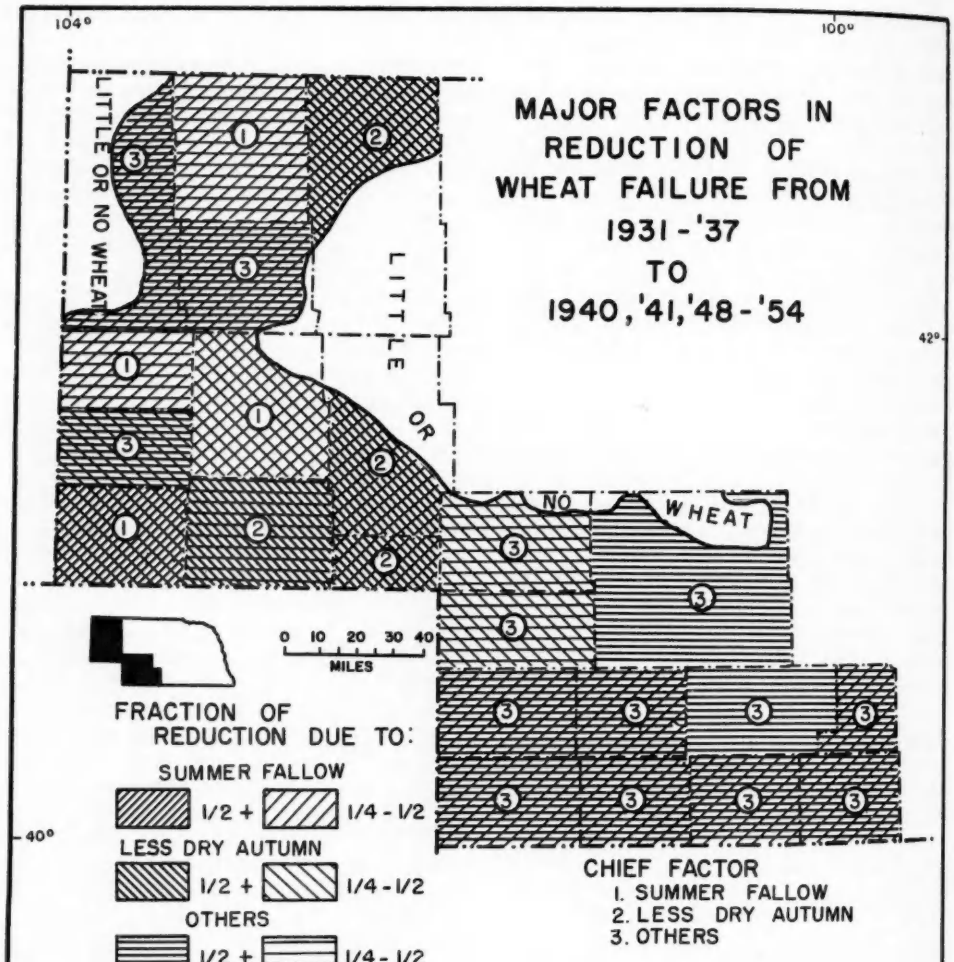

FIG. 20. Major factors in reduction of wheat failure 1931–37 to 1940, '41, '48–'54. These same factors are probably applicable to the reduction from 1931–37 to '38–'54. Amount of reduction and percentage of reduction are, of course, different matters.

1890's resulted in a general flight of recently established farmers from western Nebraska, the exodus occurring in the 1930's was only moderate. In fact, it appears that a substantial number of those operating farms in the area in the early 1930's still are farming there after a quarter-century. For example, the total number of farm operators listed in the *Western Nebraska Observer* in 1933 as cooperating in the AAA wheat program in four precincts (only four of six were reported) of Kimball County was 413. The 1955 Wheat Listing Sheet, U. S. D. A. Commodity Stabilization Service, for the same precincts (Antelope, South Divide, Dix, and Union) contained 88 of the names from the 1933 list. Of the 88, 47 were listed as operators, 41 (doubtless largely retired) as owners but not operators; 70 listed Kimball County addresses, and only nine had post office addresses more than 50 miles from Kimball County. In addition, in 88 other instances the same family name

occurred in both the lists of 1933 and 1955. Of these 88, all but 27 were farm operators, and all but 12 lived in the county.[41] It seems safe to assume that much of the experience gained in weathering the drought and depression of the 1930's has been used to advantage since that time. This may be a major factor.

Finally, farm operators with the use of greater mechanical power are in position to carry out essential farm operations more promptly even on the larger acreages of wheat now farmed. This advantage may be large.

Climatic factors other than autumn precipitation may have had considerable roles in the reduction of wheat failure. However, the low correspondence of summer precipitation, spring precipitation, winter precipitation, and of late spring temperature with percentage of failure indicates that no one of these can be of major importance. Possibly, multiple correlation techniques might provide some answers. Lack of adequate data precludes a quantitative appraisal of wind as a factor although scrutiny of limited records at hand suggests that wind velocity has little relevance to the problem.

CONCLUSION

Factors that have contributed to a large reduction in wheat failure in western Nebraska since 1937 are numerous. Several can be identified as of major importance. Among these are: (1) increased use of summer fallow, (2) more adequate autumn precipitation in more than one-half the area, (3) probably much better control of blowing, especially in and adjacent to the panhandle, and (4) accumulated experience. Perhaps the greater use of power and adapted machinery is a major cause. Possibly meriting listing as a major cause is reduced grasshopper damage. Others that have contributed to the reduction but appear to deserve listing only as minor factors are: planting on the contour, probably potentially a major factor in southwestern Nebraska; reduced disease damage; use of the deep-furrow drill in the panhandle; change in varieties of wheat grown; and the good fortune that there have been fewer *successive years* of high failure. The reduction in failure seems to have occurred in spite of increased losses due to hail.

Figure 20 is an attempt to localize by counties the chief causes of reduction of wheat failure from 1931–37 to the later period. In the appraisal of the map it should be kept in mind that the third category, "others," is plural. If it were possible to assign quantitative values to each of the factors grouped under that heading, it is probable that both summer fallow and less dry autumns would be the leading factors in some counties not so classified in Figure 20.

Implications for the future can be recognized in the trends in wheat failure experienced from 1931 to 1954 and in appraisal of factors involved. All but one of the major factors identified as making for improvement and most of those considered of minor importance are *cultural* and thus subject to a large measure of human control. The chief exception is autumn precipitation. On the basis of the record, it is not reasonable to expect a repetition of the extremely high failures that characterized most of western Nebraska in the years 1931 to 1937. In western Nebraska it appears that the dry farming leg of the economic tripod as far as can be judged by wheat failure is now more stable than it is commonly reputed to be. It will be interesting to learn the degree to which this conclusion applies to other parts of the hard winter wheat region where dry farming is emphasized.

[41] For these same four precincts a count of all operators on the 1955 wheat list gave a total of 411 tenant operators, of whom only 46 gave an address outside Kimball County, and only five more than 50 miles outside the county; 129 owner–operators, of whom only 13 lived outside the county and only three more than 50 miles away. In addition, there were 411 owner nonoperators, of whom only 145 lived in Kimball County, 50 within 50 miles, and 216 more than 50 miles away. The proportion of nonresident owners is large but suitcase farmers are scarce.

CHANGING ECONOMY AND LANDSCAPE IN A MISSOURI OZARKS AREA[1]

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ONLY two of the generally recognized regions of the Ozark Highland of Missouri,[2] Arkansas, and Oklahoma are well-known to geographers as a result of detailed investigations: the Northern Ozark Border[3] (see Missouri River Border in Figure 1) and the Oklahoma Ozarks.[4] The extensive interior of the highland in southern Missouri (Regions 4–8 in Fig. 1) and northern Arkansas has received little attention.[5] Because this section is the archetype of the Ozarks—the area that best exemplifies the landscape features, such as hilliness and sparse population, commonly associated with the province—it is deserving of careful study.

The investigation reported in this article has concerned man's role in the upland heart of the Ozarks in using resources and altering the landscape. This subject is both interesting and important. Interest is aroused by the unusual changes that have occurred in human activities and their expression in the landscape during the history of settlement. Man has at various times exploited game, mineral, forest, and soil resources in an effort to support himself in this poor environment. Never has the economy been dominated by a single type of natural resource as in some other regions, i.e., fertile soils and grain farming in the Corn Belt; coal and its mining in the central Appalachian plateau. The importance of this subject comes from a growing need to understand the less well-endowed areas of the United States so that they may be used wisely and efficiently, as population and the pressure upon resources continue to expand in the future.

The investigation included two phases. First, a study was made of the eastern part of Dent County (Figs. 1, 2), detailing the changes in economy and landscape that have occurred during the period of settlement. The four townships of eastern Dent County, which have a total area of 209 square miles, are located in the Courtois Hills, the most rugged region of the Missouri Ozarks (Fig. 1). The conversion of these townships into a national forest in 1939 has provided an opportunity to study the landscape effects of this change in ownership and management of the land. Second, attention was centered upon the Courtois Hills, considering the economic structure and landscape of this region which is the larger counterpart of eastern Dent County.

Field study in Dent County and nearby areas occupied the summer of 1950. Field observations were supplemented by interviews with local observers. The records of Salem Ranger District of Clark National Forest, census reports, and various other library materials provided useful data.

EASTERN DENT COUNTY

The Natural Landscape

Eastern Dent County is located in the northwestern Courtois Hills in the east central part of the Ozark Plateau (Figs. 1, 17). After erosion truncated the Ozark Dome of Paleozoic sediments to form the Ozark Plateau, the latter was deeply dissected by streams on its outer margins to form hilly areas. Sauer named the undissected interior of the Ozark Plateau the Central Plateau and recognized

[1] The research leading to this report was aided by University of Nevada research grants.

[2] Regions of the Missouri Ozarks follow those proposed by Carl O. Sauer in *Geography of the Ozark Highland of Missouri*, The Geographical Society of Chicago, Bulletin No. 7 (1920); see especially Figure 18 and pp. 61–70. James E. Collier used very similar regions for the Missouri Ozarks in: "Geographic Regions of Missouri," *Annals*, Association of American Geographers, Vol. 45 (1955), pp. 368–92.

[3] James E. Collier, *Geography of the Ozark Border Region in Missouri*, University of Missouri Studies, Vol. 26, No. 1 (1953); A. B. Cozzens, "Conservation in German Settlements of the Missouri Ozarks," *Geographical Review*, Vol. 33 (1943), pp. 286–98.

[4] Leslie Hewes, "The Oklahoma Ozarks as the Land of the Cherokees," *Geographical Review*, Vol. 32 (1942), pp. 269–81; Leslie Hewes, "Cultural Fault Line in the Cherokee Country," *Economic Geography*, Vol. 19 (1943), pp. 136–42.

[5] Two articles dealing with areas in the interior Ozarks of Missouri are: W. A. Browne, "Some Frontier Conditions in the Hilly Portion of the Ozarks," *Journal of Geography*, Vol. 28 (1929), pp. 181–88; Margaret Riggs, "Valley Contrasts in the Missouri Ozarks Regions," *Journal of Geography*, Vol. 35 (1936), pp. 351–59.

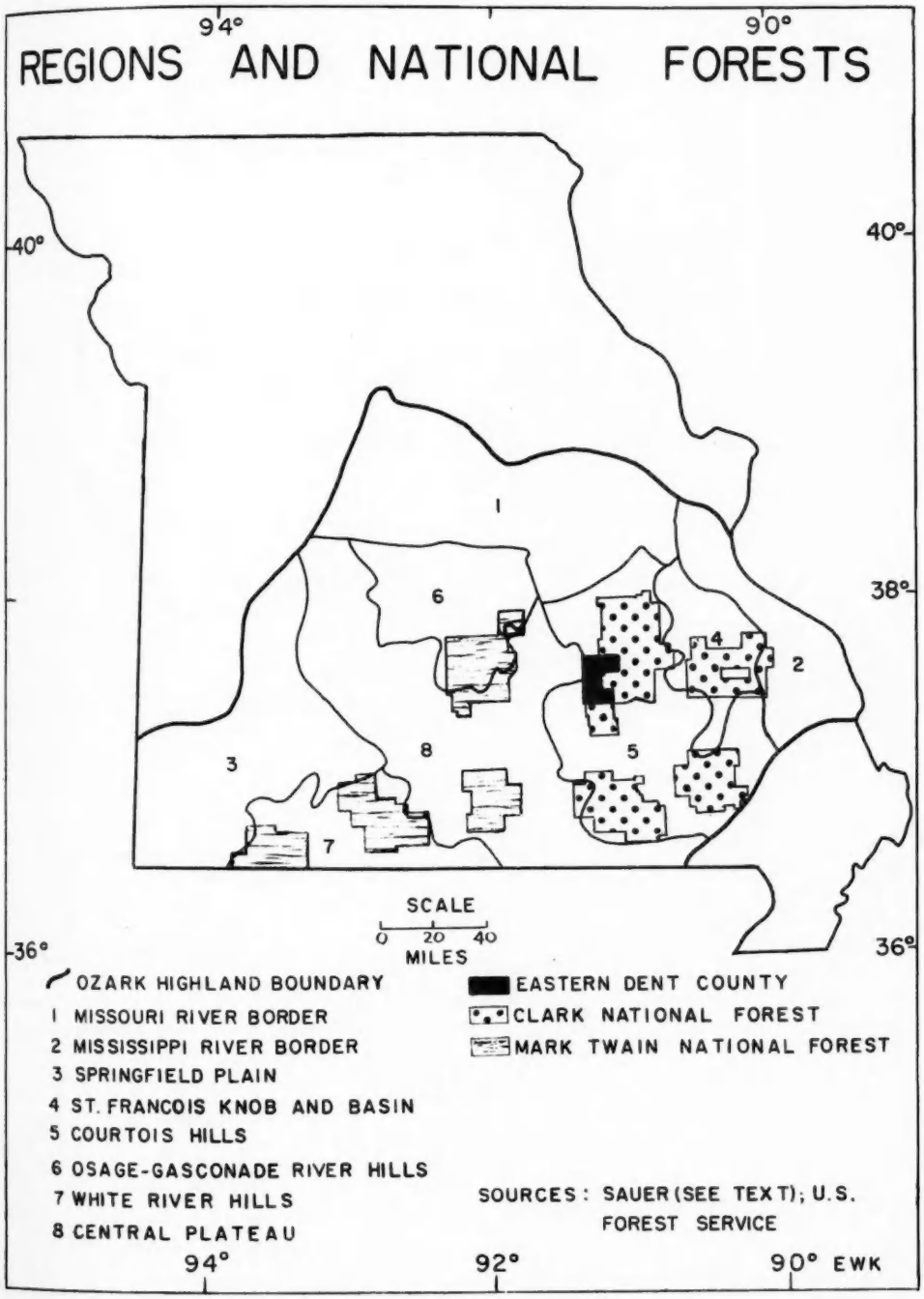

FIG. 1. Regions and National Forests of the Ozark Highland of Missouri.

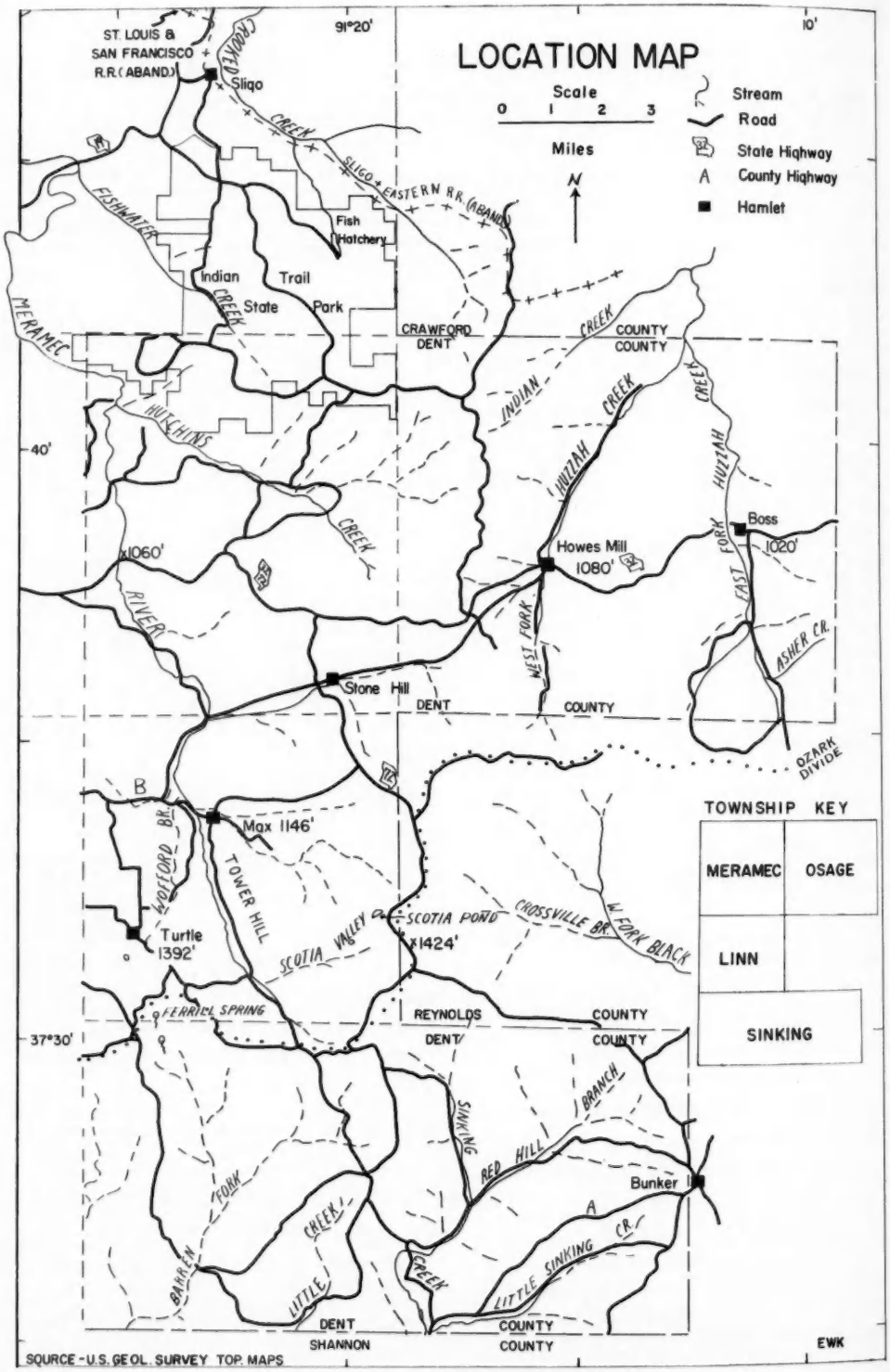

FIG. 2. Location map of eastern Dent County.

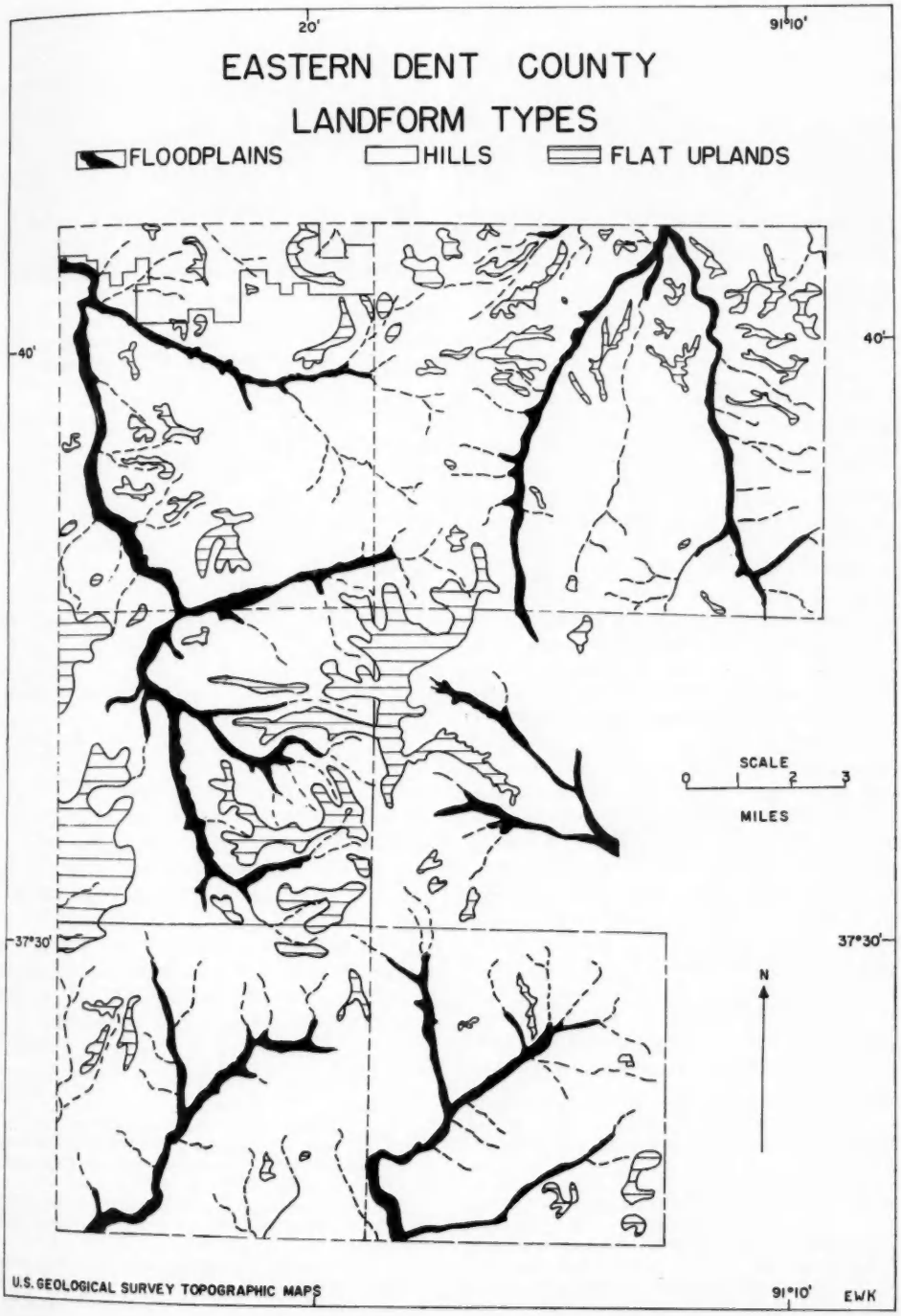

Fig. 3. Landform types of eastern Dent County.

FIG. 4. Level upland remnant on main Ozark divide in Reynolds County just south of Osage Township, Dent County. A few poor-quality shortleaf pine trees are scattered about the area.

FIG. 5. Valley of West Fork of Huzzah Creek in Osage Township. Hay land is in foreground and stream lies beyond at base of distant hill. Cleared pasture on hill has been invaded by tree sprouts.

three hilly regions disposed about the flat upland: the Courtois Hills on the east, the Osage-Gasconade River Hills on the north, and the White River Hills on the south and southwest.

Stream action and solution acting upon the cherty dolomites of the Eminence (Cambrian) and Gasconade (Ordivician) formations have produced the present rough surface of the eastern townships of Dent County.[6] The area is a maze of narrow valleys and steep-sided hills drained by Meramec River and its tributaries north of the main Ozark divide, and by the Sinking Creek system in the country to the south (Figs. 2, 3). The small valleys in this watershed location are seldom more than 1,000 feet wide. Local relief ranges around 150 to 200 feet. The hillsides are mantled with yellowish chert stones left after the solution and removal of dolomite. Remainders of the former plateau in this region are occasional flat uplands (Figs. 3, 4). Solution has formed numerous sinks and springs.

Narrow strips of alluvial Huntington soils in the valley bottoms are the mainstay of agriculture, while the Clarksville stony loam soils of rocky uplands remain in forest.[7] Alluvial soils were the first to be cleared and farmed, and today they are the major basis of crop production (Figs. 5, 6). The smaller valleys are of scant value because they have limited extent and light, sometimes gravelly, soils. Clarksville stony loam is unsuited to agriculture because it occurs on steep slopes and has a high chert content, ranging from 25 to 90 percent of the soil mass.[8] Clarksville gravelly loam, closely related to the stony loam but lower in chert content, occurs on moderate slopes above the floodplains. It has been cleared extensively and used for pasture (Fig. 7).

The oak–hickory association of the eastern deciduous forest occupies most of the uplands of the central and eastern Ozarks of Missouri.[9] Southern Missouri forests are termed "the oak–pine association" because of the presence here of shortleaf pine (*Pinus echinata*).[10] Oak–pine forest occurs in Sinking Township and the southeastern part of Linn Township, and oak–hickory forest occupies the area to the north. The forest was originally quite open and alternated with stretches of prairies. Grasslands were common in the plateau remnants. The disappearance of these prairies is one of the most conspicuous landscape changes

[6] Geological Map of Missouri, 1:500,000 (Missouri Division of Geological Survey and Water Resources, 1939); various U. S. Geological Survey topographic quadrangles.

[7] "Reconnaissance Soil Map of the Ozark Region," in Curtis F. Marbut, *Soil Reconnaissance of the Ozark Region of Missouri and Arkansas*, U. S. Department of Agriculture, Field Operations of Bureau of Soils, 1911 (Washington, D. C., 1912); "Reconnaissance Survey Soil Map of Missouri," 1:750,000, University of Missouri Agricultural Experiment Station (Columbia, 1930).

[8] M. F. Miller and H. H. Krusekopf, *Soils of Missouri*, Research Bulletin No. 264, University of Missouri College of Agriculture, Agricultural Experiment Station (Columbia, 1931) p. 75.

[9] John E. Weaver and Frederic E. Clements, *Plant Ecology* (2d ed.; New York, 1938), pp. 508–16 and frontispiece.

[10] F. G. Liming, *The Range and Distribution of Shortleaf Pine in Missouri*, Technical Paper No. 106, Central States Forest Experiment Station (Columbus, Ohio, 1946).

FIG. 6. Profile of Huntington soil on bank of Meramec River, Meramec Township. Several layers of alluvium totaling about 6 feet in depth are visible. The land is in hay and pasture.

FIG. 7. Lower slope pasture adjoining floodplain of West Fork of Huzzah Creek, Osage Township. Clarksville gravelly loam is typical of such a site.

that has occurred in the Ozarks during the last century.[11]

The forest on hilltops in eastern Dent County and adjacent areas is a rather scrubby growth of post oak (*Quercus stellata*) and blackjack oak (*Q. marilandica*); shortleaf pine is particularly important upon rocky uplands.[12] The middle and lower slopes of the hills have black oak (*Q. velutina*), white oak (*Q. alba*), post oak, several species of hickory, and shortleaf pine. Bottomland forests, now largely cleared, are composed of sycamore (*Plantanus occidentalis*), river birch (*Betula nigra*), and sugar maple (*Acer saccharum*), along with elms and willows.

Early Settlement

Shortly after 1800, frontiersmen from the Upper South began to cross the Mississippi and settle in the eastern Ozarks. The first farm in Dent County was cleared on a tributary of the Meramec River in 1828.[13] Soon many pioneers were moving into the valleys where timber and water were available; they avoided the rocky, open uplands.

Hunting and stock raising supplied the needs of the early settlers. Game was plentiful, and cattle and sheep could be ranged in the uplands through the warmer months, while corn was grown on cleared lands in the valleys. Each year, the Ozark frontiersmen set fire to the wooded slopes above the valleys to kill the trees and promote the growth of grass for forage. Even today some farmers in the Courtois Hills and other interior Ozark areas burn their woodlands, although the custom was abandoned long ago in the more densely settled areas.[14]

In these early years of isolation, the nearest trading center was Meramec Iron Works, located about 30 miles north of Dent County.[15] An overland trip to St. Louis by oxcart took two weeks or more.[16] The few products available for sale, such as furs, hides, and beeswax, were marketed in these places.[17] Population grew rather slowly in these first years of settlement. Following a period of heavy land entries in the 1850's, the census of 1860 reported 5,600 people in Dent County, with one-fifth of this number in the four eastern townships (Fig. 9). The Civil War brought warfare, chaos, and population decline. After the war, however, economic growth resumed with vigor.

Iron and Timber Exploitation

The completion in 1873 of the St. Louis, Salem and Little Rock Railroad to link the

[11] Carl O. Sauer, *op. cit.*, pp. 52–56 and 156–58; August P. Beilmann and Louis G. Brenner, "Forest Intrusion in the Ozarks," *Annals*, Missouri Botanical Gardens, Vol. 38 (1951), pp. 261–82.

[12] Forest composition was compiled from field data, Forest Service records, and the following principal publication: Forest Service, North Central Region, *Forest and Land Management of Reynolds County, Missouri* (Milwaukee, 1942).

[13] R. A. Campbell, ed., *Campbell's Gazetteer of Missouri* (St. Louis, 1874), p. 193.

[14] The problem of burning in the Ozarks is worthy of further study. One interesting question concerns the effects of burning upon runoff and erosion in this environment.

[15] *History of Laclede, Camden, Dallas, Webster, Wright, Texas, Pulaski, Phelps and Dent Counties* (Chicago, 1889), p. 569, 572.

[16] J. R. Pemberton, "A Brief History of Stone Hill," in P. A. Wobus, *Historical Sketch of the Early Days of Dent County, Missouri* (Stone Hill, Missouri, 1928), p. 7.

[17] *Ibid.*

town of Salem in the center of Dent County with Cuba on the Pacific Railroad to the north signaled the start of a race to develop the mineral and forest resources accessible to the railroad.

Iron deposits occur widely in the eastern Ozarks, but most are small and of low quality. Small, scattered deposits of good quality hematite ore in the Meramec Valley[18] had attracted interest for decades. Development came first to the more accessible deposits near the northern edge of the Courtois Hills. As early as 1819, iron was mined and smelted in a charcoal furnace near Bourbon in Crawford County.[19] Ten years later the Meramec Iron Works began operations near St. James, a few miles to the west.[20]

As soon as effective transportation reached southward into the interior of the Courtois Hills, iron mining and smelting started. By 1874, only a year after the completion of the railroad to Salem, thirty "banks" of iron ore were in production in Dent County alone.[21] In 1880, the Sligo Furnace Company established an iron furnace in northeastern Dent County, about 7 miles north of Meramec Township (Fig. 2).[22] The next year Scotia Furnace, which had been operating in northern Crawford County, was dismantled and moved to southeastern Linn Township in Dent County and renamed Nova Scotia Furnace. Here a town of 100 families grew up. However, after four years the furnace closed down because of high transportation costs. The only present-day reminders of Nova Scotia Furnace at the overgrown site are cellar holes and the Scotia ponds which were formerly reservoirs.

Sligo Furnace has been described as the "most successful of the later charcoal furnaces in Missouri."[23] The enterprise was rather well located (Figs. 2, 17). It was accessible to the iron mines of Dent and Crawford counties, water was available from Crooked Creek, and the nearby hills supplied abundant wood for charcoal. In 1881, a short branch line was built to Sligo from the St. Louis, Salem and Little Rock Railroad to provide rail connections with St. Louis, Springfield, and other cities. After several early improvements, the furnace produced daily about 80 tons of charcoal iron, consuming in the process 150 cords of wood.[24] The tough and resilient product was sold readily in Midwestern and Eastern steel fabricating centers.

Sligo Furnace brought many people to the region in which it operated. The town of Sligo which grew about the furnace (Fig. 8) had nearly 500 residents in 1890, as recorded in the census, and about 800 during the 1900-20 period, according to estimates.[25] Sligo was by far the largest settlement in the hilly, sparsely occupied country extending north and east from Salem as far as Steelville. The iron industry was the sole or chief support of thousands of miners, woodcutters, charcoal burners, teamsters, and farmers in the surrounding region, especially in Dent and Crawford counties.

The furnace brought devastation to the accessible forests. The main center of wood and charcoal operations surrounding Sligo became known as the Sligo Choppings. By 1900, when wood supplies in this area were exhausted, charcoal making moved eastward into the undepleted forests of southern Crawford County and northern Osage Township of Dent County. A railroad was built from Sligo eastward into this area to expedite the movement of charcoal.

Commercial lumbering developed somewhat later than the mineral industry. A major reason for this was the inaccessibility of the best timber stands, located in the heart of the Courtois Hills. The railroad on its arrival at Salem failed to stimulate large-scale lumbering in the poorly forested area of central Dent

[18] G. W. Crane, *The Iron Ores of Missouri*, Missouri Bureau of Geology and Mines, Vol. 10, 2d Series, (1912), pp. 84–85.

[19] F. L. Nason, *Report on the Iron Ores of Missouri*, Geological Survey of Missouri (1892), p. 309.

[20] O. M. Bishop, *The Mineral Industry of Missouri in 1946 and 1947 with Total Production Summarized*, Information Circular No. 4, Missouri Division of Geological Survey and Water Resources (Rolla, Missouri, 1949), p. 33.

[21] R. A. Campbell, *op. cit.*, p. 195.

[22] The late Hon. W. P. Elmer of Salem, Missouri, former attorney for the Sligo Furnace Company, supplied much valuable information concerning the iron industry of Dent County in interviews during the summer of 1950.

[23] A. B. Cozzens, "The Iron Industry of Missouri," *Missouri Historical Review*, Vol. 36 (1949), p. 57.

[24] The late Hon. W. P. Elmer, personal communication, August, 1950.

[25] W. A. Dunlap, Sligo, Missouri, personal communication, June, 1950; the late Hon. W. P. Elmer, personal communication, August, 1950.

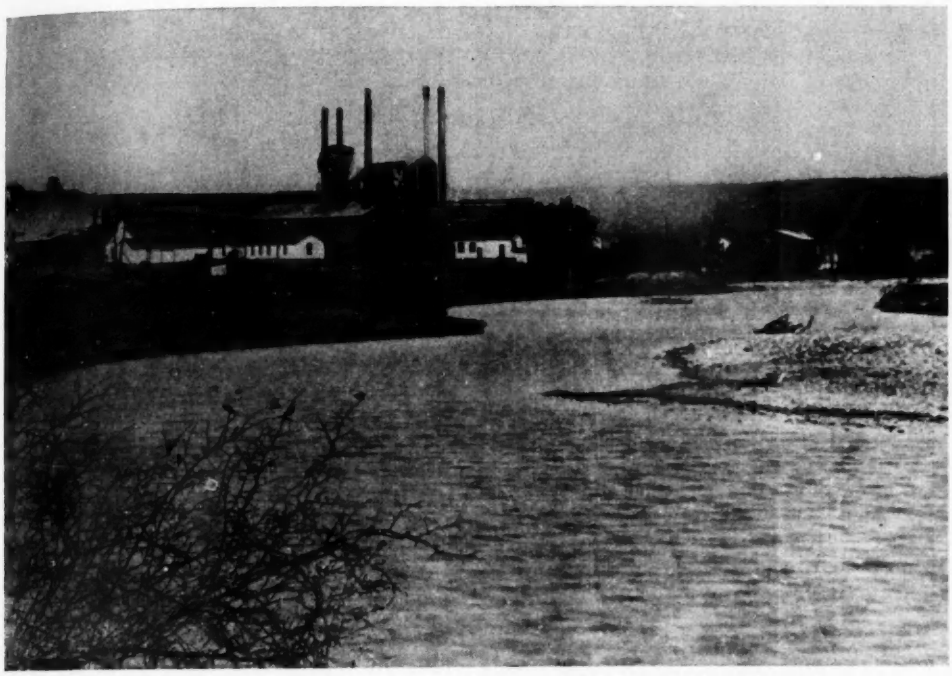

FIG. 8. Sligo Furnace about 1915. Photograph courtesy of W. A. Dunlap, Sligo, Missouri.

County. However, small lumber mills began to appear in the country south and east of Salem, where more timber was available. By 1880, census reports showed 10 mills, probably small ones, operating in Reynolds County to the east.

Major lumbering activity came to the Courtois Hills when railroads penetrated the region from the east. Near the close of the 19th century, the Missouri Southern Railroad was built from Poplar Bluff northwestward into the the Courtois Hills (Fig. 17). At the turn of the century, the railroad reached Bunker on the Dent County-Reynolds County border (Fig. 2). In 1909, a larger lumber mill was established at Bunker to process the pine and oak logs which were being cut in the surrounding hills. Bunker, a small settlement before this time, became the home of some 800 people during the next dozen years.

Agriculture prospered during the last years of the 19th century. Many new farms were established. Census reports show that improved land on Dent County farms increased from 23,000 acres in 1870 to nearly 73,000 in 1890. With rail transportation available at Salem and local markets growing, farmers were encouraged to raise crops and livestock for sale. By 1880, wheat, a ready cash crop, had risen to a position second only to corn. It occupied 25 percent of the cropland.

The diversity and productivity of the economy at this time is illustrated by the list of rail shipments from the county shown in Table 1.

TABLE 1.—SELECTED ITEMS FROM LIST OF DENT COUNTY RAIL SHIPMENTS IN 1893[1]

Item	Amount shipped
Pig iron	214 cars
Railroad ties	203 cars
Lumber	128 cars
Charcoal	29 cars
Game	58,910 lbs.
Wheat	60,300 bus.
Cattle	4,945 hd.
Hogs	12,043 hd.
Poultry	203,965 lbs.
Eggs	217,060 lbs.
Wool	56,760 lbs.

[1] Missouri State Board of Agriculture, *26th Annual Report* (Jefferson City, 1894), p. 293.

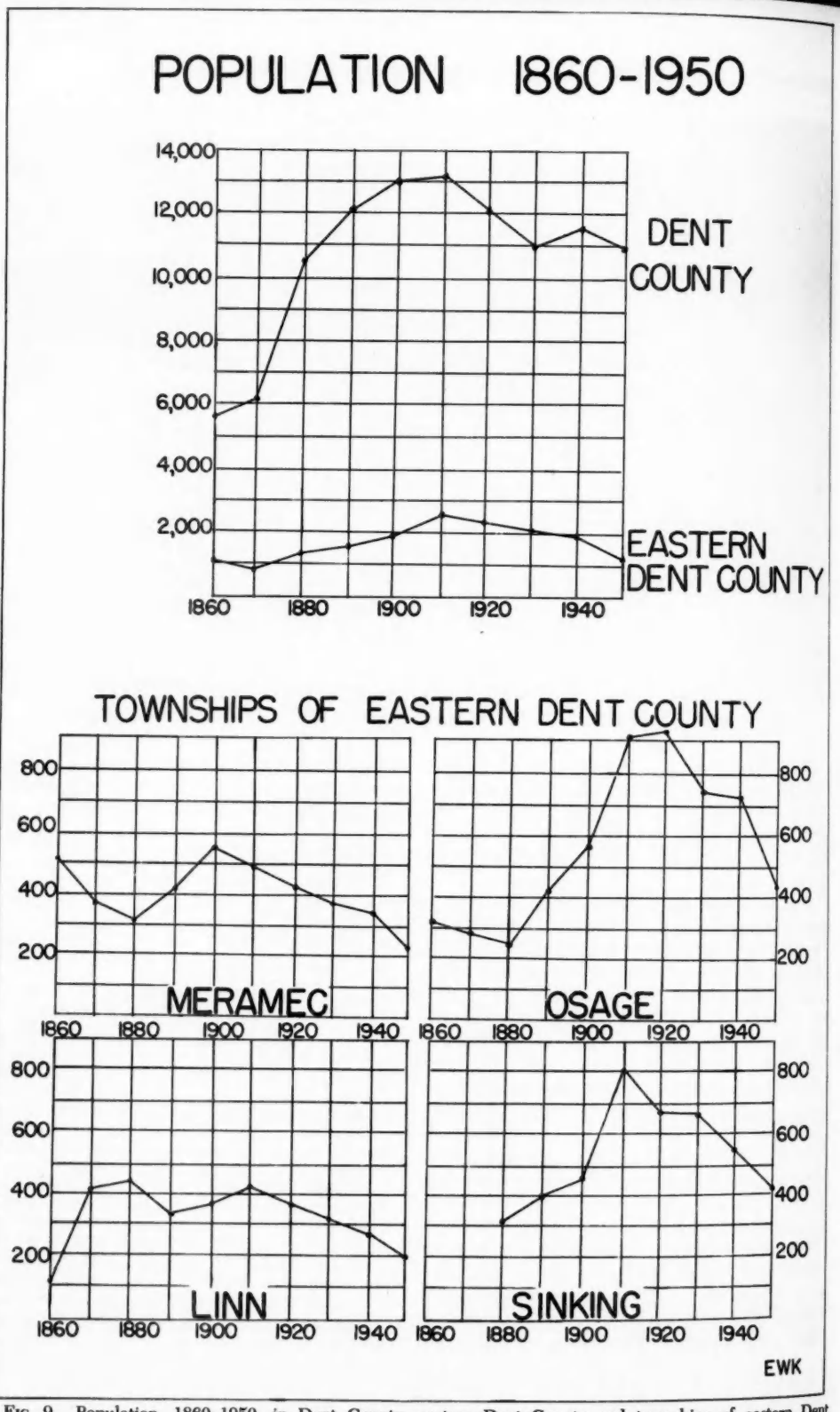

FIG. 9. Population, 1860–1950, in Dent County, eastern Dent County and townships of eastern Dent County. Source: United States census data.

FIG. 10. Abandoned farmhouse at Stone Hill, Meramec Township.

FIG. 11. Unoccupied farmhouse on upper West Fork of Huzzah Creek in Osage Township. The land of the farm is in cultivation.

Although iron and timber led the exports, there was a lively trade in livestock, livestock products, and wheat. The inclusion of game on the list of shipments illustrates that hunting, an expression of a frontier way of life, persisted in this region fully two generations after pioneering began.

The relative prosperity that had come with the rise of new industries in the 1870's and 1880's could last no longer than the exploited resources. Collapse came when the iron and timber were used up. Increasing signs in the early years of the 20th century foretold the end. Sligo experienced great difficulty in obtaining adequate supplies of iron ore and charcoal. Lake Superior ore was shipped in to supplement dwindling local supplies. Charcoal making migrated each year farther from the furnace as the Sligo and Eastern Railroad pushed more than 25 miles southeastward through the Courtois Hills to tap new wood supplies. Settlements like Bixby, Goodland, and East End sprang up along the railroad. Though high prices during World War I helped the company to continue, the slump in prices after the war hastened its end. In 1921, when the plant required costly repairs, Sligo Furnace ceased operations.

Large-scale lumbering in Sinking Township and adjacent Reynolds and Shannon county areas came to an end at the same time. The mill which had been established at Bunker in 1909 built rail lines into the surrounding country and "logged over" this area during the succeeding years. It closed in 1921 after all the usable timber had been cut.

Economic Decline

Rural population decline, caused by the movement of people to cities, began about 1900 in many parts of the Ozarks. However, Dent County reached its peak population in 1910 (Fig. 9) and the decline was only slight during the next decade, because iron and lumber industries employed many people who might otherwise have left for the cities. ***But the collapse of these industries changed all this.*** Jobless iron workers and loggers joined small farmers in an exodus from an area where the opportunity to make a living seemed to have disappeared. Short Bend Township, in which Sligo is located, lost half its population between 1920 and 1930, according to the census. Sligo, Bunker, and other settlements serving the iron and lumber industries declined. Sligo Furnace and most of the residences were moved from the town. Bunker too lost much population but retained its old tradition in later years as small lumber mills operated there.[26] Abandoned or vacant houses became commonplace features (Figs. 10, 11) as a result of this population decline.

Commercial agriculture languished after the turn of the century because of the loss of markets. Outside wheat and beef markets were given up to more efficient producers in the central and western states and local markets declined as people left the area. Many problems hindered progress in agriculture: inadequate areas of farmland, backward methods, low yields, poor quality livestock, and the distraction of farmers with other activities such as logging, hunting or iron work. The only bright spot in this sad picture was the

[26] George A. Stokes has described in Louisiana a similar trend from the large mill and company town to small portable mills when the virgin forests were exhausted. This, he states, was common in the South. See: "Lumbering and Louisiana Landscapes," *Annals*, Association of American Geographers, Vol. 47 (1957), pp. 255–56.

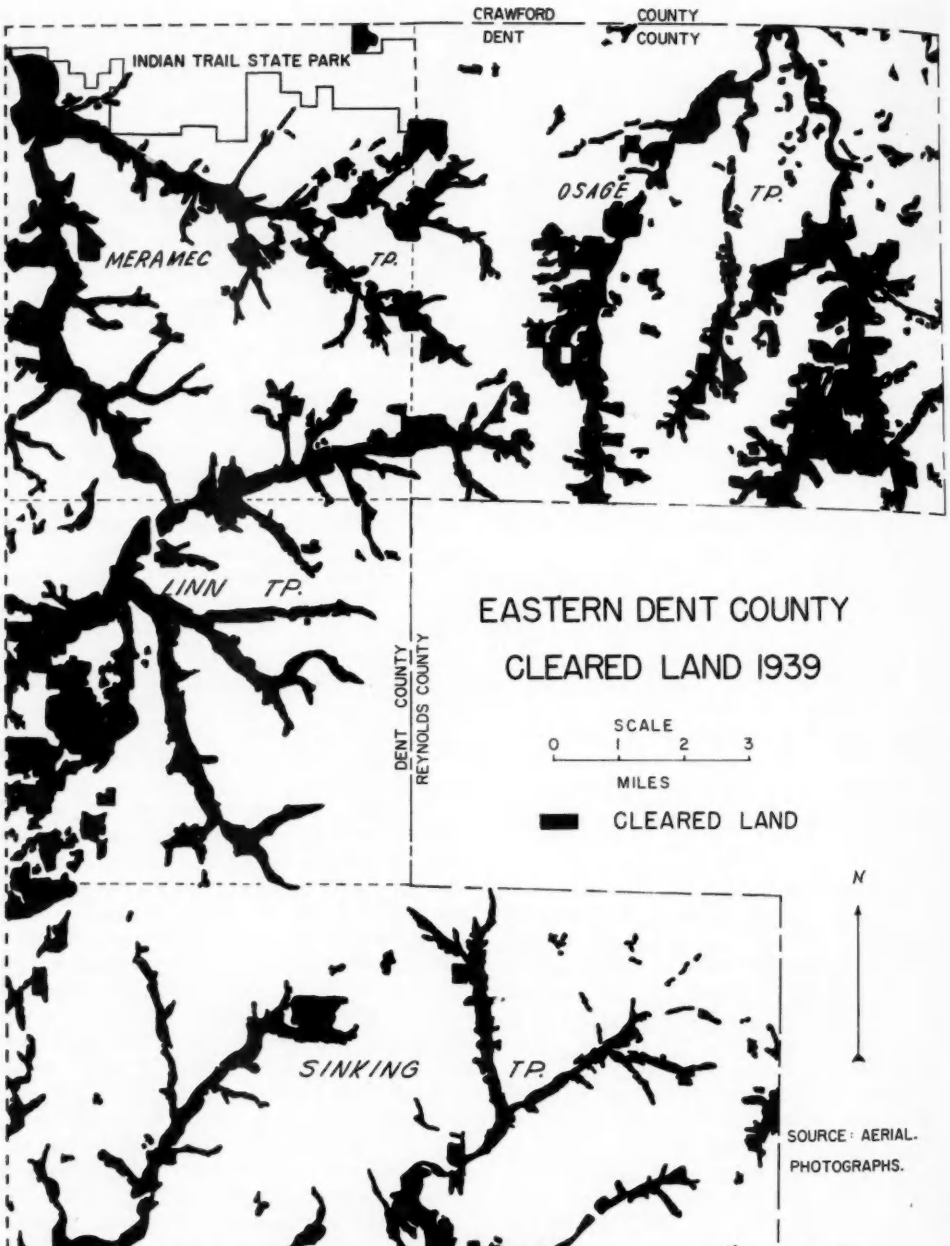

FIG. 12. Cleared Land in 1939 in eastern Dent County.

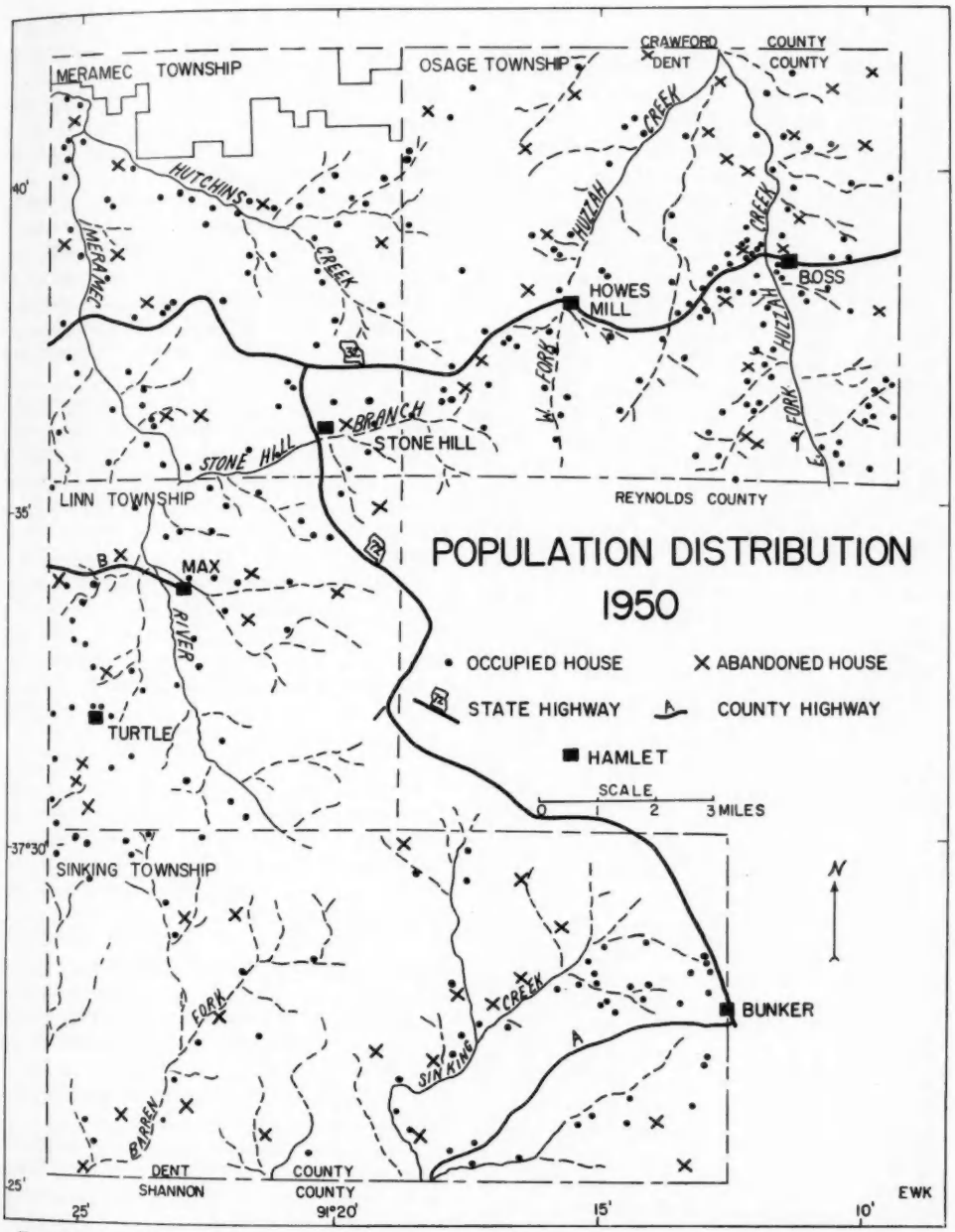

FIG. 13. Population distribution in 1950 in eastern Dent County. Sources: "General Highway Map, Dent County, Missouri," Scale: approximately one inch equals one mile, Missouri State Highway Department (Jefferson City, 1949); United States Geological Survey topographic quadrangles; field data.

town of Salem. While other areas were declining, this center increased in population and importance.

A view of the landscape as it appeared in 1930 provides a vantage point for a look at the changes wrought during a century of set-

tlement. The upland scene was a sad one, profoundly altered from its original aspect. The prairies had long since been eliminated, while annual burning and heavy logging had greatly depleted the forests. A highly competent observer describes the uplands at this time:

> At that time, a large portion of the woodland was free of low vegetation or young tree growth. As a result of the practice of annual burning of the woods, one could see for great distances, and the ground appeared to be covered almost entirely with rocks, with very little soil showing . . . . This was a very discouraging picture with regard to the management of forest lands.[27]

Much of the forest had been logged more than once. Forest Service records show that half the forest land acquired in Dent County had trees of sapling size or smaller. Some lands were completely deforested. Fire-scarred and diseased trees were the rule. Decay commonly occurs after fires, as fungal spores enter the wood through fire wounds.[28] Perhaps the most unfortunate factor was the total lack of interest in the welfare and the care of these devastated lands by most of the owners. Many owners lived in distant areas. Land was burned and grazed indiscriminately and timber was stolen from it. A noteworthy exception to this occurred in 1924 when the state purchased a large tract of the Sligo Choppings in Meramec and Short Bend townships for conversion into Indian Trail State Park.

Figure 13 provides an approximation of population distribution at this time, with abandoned houses shown as residences. The agricultural valleys held most of eastern Dent County's population. They were again the major centers of economic life as in pioneer days. There were 2,213 people in the four townships in 1930, according to the census. The density in the entire area was 10 per square mile, but density in relation to cleared land was far higher, since only about one-seventh of the land was unforested (Figs. 12, 13). Forest Service records indicate that about 12 percent of the population lived in the uplands. These hill dwellers managed a bare existence by running a few scrubby cattle in the woods, hunting, and cutting wood.

[27] G. O. White, State Forester of Missouri, letter of December 2, 1950.

[28] Paul Y. Burns, *Fire Scars and Decay in Missouri Oaks*, University of Missouri Agricultural Experiment Station Bulletin 642 (1955), p. 3.

Farms were of modest size with large acreages of woodland. The average size in eastern Dent County was 187 acres with only 30 to 50 percent of this land cleared, as reported in the census of 1930. Much mediocre lower slope land was being farmed along with the floodplain lands (compare Figs. 3 and 12). Farming methods had changed little during the preceding half-century. Corn, small grains, and hay dominated valley land use while livestock grazed in the uplands under the open range system.[29] Continuous cropping with grains had seriously lowered the fertility of farm lands and erosion damage was common.

Isolation was a prominent feature of this landscape. Farmhouses in the valleys were usually reached by steep, rocky trails winding down from the main roads, which followed divides. Valley roads were rough and interrupted frequently by stream fords, which became impassable at times of high water.

Salem, located near the eastern edge of the Central Plateau adjoining the Courtois Hills, served parts of both regions as a trade and service center. Census reports show that the town increased in population from 1,771 in 1920 to 2,250 in 1930.

A New Departure in Recent Years

In 1930, the prospects for a better day must have seemed poor. Yet the next quarter century was a time of remarkable changes which have moved this area along the path of economic recovery. This surprising reversal has followed several lines:

1. The creation of Clark National Forest brought federal forest management to the uplands.
2. Great improvements have taken place in agricultural land use, in cattle breeding, and in size of farm units.
3. Mining, after decades of inactivity, has started a major revival.
4. Population has continued its earlier decline in the rural eastern townships. Losses have been larger in the uplands and smaller valleys than elsewhere.

[29] In 1935 about 170 townships in the Missouri Ozarks still had open range laws, under which stock could graze on all unfenced lands regardless of ownership. See D. B. King, *et al.*, *Forest Resources and Industries of Missouri*, University of Missouri Agricultural Experiment Station Research Bulletin No. 452 (Columbia, 1949), pp. 58–59.

5. Salem has grown actively, adding new industry and commerce and attracting population from the rural areas.

6. Small beginnings have been made in tourism and resorts, activities which have great potential.

In 1933, the federal government designated eight Ozark areas as national forest purchase units.[30] The two national forests of Missouri —Clark National Forest in the eastern Ozarks and Mark Twain National Forest in the western part of the highland (Fig. 1)—developed from this action. Eastern Dent County is located in the northwestern unit of Clark National Forest within the boundaries of the Salem Ranger District. The national forests of Missouri include much private land, generally owned by local farmers. Commonly, the Forest Service controls upland areas while private owners hold the cleared valleys and nearby wooded slopes.

When the Forest Service took control of the uplands of eastern Dent County, a new regime in land management replaced the exploitative, neglectful system of the past. The major objective of Forest Service activities here has been to restore and maintain the forest resource.

One of the first changes in the upland landscape was the removal of population from lands controlled by Clark National Forest. About 200 people, or 10 percent of the population of eastern Dent County in 1930, lived on these lands, many of them as squatters. The Forest Service required most occupants to leave but allowed a few to remain under "special use" permits.[31]

The problem of controlling fires proved to be one of the most challenging ever faced by the Forest Service. In 1936, there were 1,600 fires in Clark National Forest;[32] such a number seems incredible unless one knows of the burning tradition. Poor transportation and the the deeply ingrained custom of burning hampered early fire-control efforts. However, Civilian Conservation Corps crews soon pushed roads into isolated areas, opening them up to fire-fighters. Educational efforts promoted forest conservation and opposed woods burning. The number of fires in Salem Ranger District declined from 203 in 1939 to only 39 in 1950.[33] Even now, however, "brush clearing fires" and "work fires" remain important problems. The former occur as farmers burning their woodlands carelessly allow fires to spread to neighboring national forest lands; the latter are deliberately set by individuals in order to get work as fire-fighters.

Open range grazing — a long established practice everywhere in eastern Dent County except in Meramec Township—has declined a great deal in the past 25 years, partly as a result of Forest Service restrictions. The Forest Service has reduced the allowable number of stock grazing on national forest lands in order to prevent serious timber damage.

When fires and grazing are controlled, depleted Ozark forests revegetate rapidly. A small proportion of the Ozark forest area had been "clean-cut," as in the Sligo Choppings. New growth soon became established in such places. However, selective lumbering had been the rule in most of the forest area. Here the problem was far more complex. The trees remaining in such areas were generally fire-damaged and diseased. How could they be eliminated to make room for healthy young trees? One way was to girdle and kill the undesirable ones. This was done in large areas. Another method used was the "improvement cut," in which case the older diseased trees were selectively logged. In spite of rot, many such trees contain some usable wood.

Adequate hardwood reforestation has taken place by sprouting from old stumps, but in the case of shortleaf pine, a planting program has been used to supplement natural regrowth. The Forest Service has promoted research upon shortleaf pine, in order to discover methods of promoting its growth. The interest in increasing stands of this conifer is based upon the fact that the tree produces good lumber, and that it grows more rapidly and in stands of greater density than the hardwoods, thereby providing more lumber per acre. Pine, of course, will never outproduce the dominant hardwoods in volume, but it can in the future add greatly to the value of Ozark lumber production.

Lumbering never completely ceased here, although the supply of timber was very small

[30] *Missouri National Forests* (information leaflet), U. S. Department of Agriculture, Forest Service (1948), p. 2.

[31] Records of Salem Ranger District, Clark National Forest, Salem, Missouri.

[32] Pete Lewis, Fire Control Director, Clark National Forest, personal communication, July, 1950.

[33] Records, Salem Ranger District, Salem, Missouri.

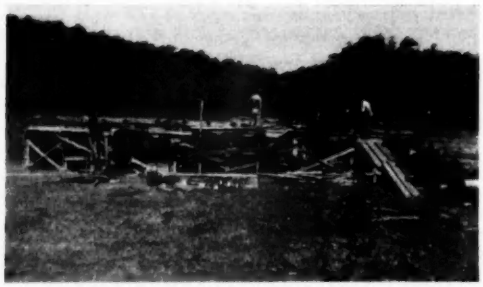

FIG. 14. Small portable lumber mill in operation about 1 mile north of Boss, Osage Township.

for many years following the completion of the heavy cutting in the early part of the century. Several small portable mills are in operation at present (Fig. 14). They are usually equipped with circular saws and gasoline motors and have crews of 4 to 6 men. The most important products in recent years have been saw timber, cross-ties, and barrel stave timber processed largely from white, black, and post oaks.[34]

A remarkable recent changeover in land use features the use of valley farmlands for improved pastures and hay instead of the corn and small grains dominant in the past (Fig. 15 and Table 2). In the summer, cattle are pastured in the valleys and nearby farm woodlands. In winter they are fed hay and grain in the valleys. Osage Township illustrates well the change from crops to pasture: census reports show that cropland declined from 4,360 acres in 1930 to 2,668 in 1950.[35] During the same interval, improved pasture increased from 1,705 to 3,005 acres.

Hay is by far the major crop in acreage; it is cut from various mixtures of timothy, Korean lespedeza, red clover, and Kentucky bluegrass. Corn, a poor second in area, still occupies the best cropland, as in Meramec Valley in Meramec Township.

Improved pasture is the leading use of cleared lands (Figs. 5, 7, 15; Table 2). About three-quarters of the cleared land in the eastern townships is in pasture; this use is practically the only one in many smaller valleys. Pasture plantings include the same grasses and legumes that are used for hay. Many hillside pastures have been only roughly cleared without removing stumps. In such clearings, volunteer grasses and legumes compete with shrubs and tree sprouts (Fig. 5).

Cattle breeding is the key to the remarkable progress which the livestock industry has made in recent years. In 1940, Dent County stock-raisers formed a registered beef cattle organization.[36] At about the same time, the South Central Missouri Hereford Breeders Association began to hold annual sales in Salem. An outgrowth of this new emphasis upon good quality livestock is the development of a specialization in feeder calves. In recent years, the Ozark section of Missouri has assumed a major role in the production of this class of animals. In 1950, most of Missouri's feeder cattle sales were held in the northern part of the state, but only five years later more than half of the sales took place south of the Missouri River (Fig. 16).[37] Ozark

[34] For a description of lumbering and marketing of lumber see: K. L. Quigley, *Marketing Farm Woodland Products in the Missouri Ozarks*, Central States Forest Experiment Station, Technical Paper 116 (1950).

[35] Photostatic records for minor civil divisions of Dent County in the 1950 census were supplied by the Bureau of the Census.

[36] Agricultural Extension Service, Dent County, Annual Report for 1949 (unpublished), p. 2.

[37] Information concerning state feeder cattle sales is provided each year by folders entitled *Missouri Annual Feeder Cattle Sales*, distributed by the University of Missouri College of Agriculture, Columbia, Missouri. The 1950 and 1955 editions were used in this report.

TABLE 2.—AGRICULTURAL USE OF CLEARED LAND IN TOWNSHIPS OF EASTERN DENT COUNTY IN 1950[1]

Township	Total cleared land (acres)	Agricultural use of mapped cleared land								
		Total acres	Hay		Corn		Pasture		Other	
			Acres	Percent of total	Acres	Percent of total	Acres	Percent of total	Acres	Percent of total
Osage	9,103	5,343	1,474	27	109	2	3,760	71	—	—
Meramec	6,959	4,617	887	19	248	5	3,463	75	19	—
Linn	2,705	1,867	256	14	263	14	1,265	68	83	4
Sinking	5,632	2,639	515	20	109	4	2,015	76	—	—
Total	24,399	14,466	3,132	22	729	5	10,503	73	102	<1

[1] Data computed from planimetric measurements of map of land utilization in 1950, Figure 15.

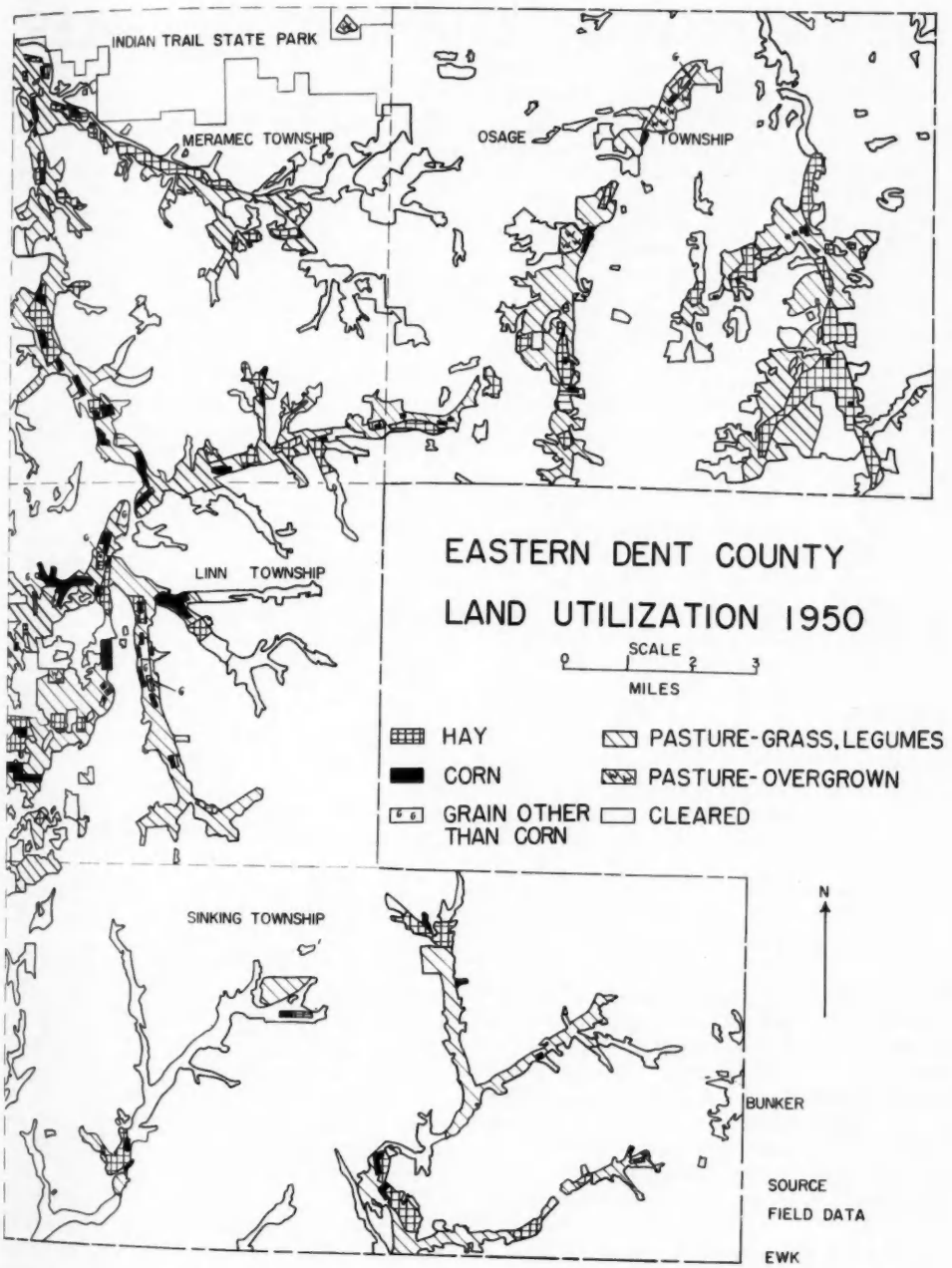

FIG. 15. Land utilization in eastern Dent County, 1950.

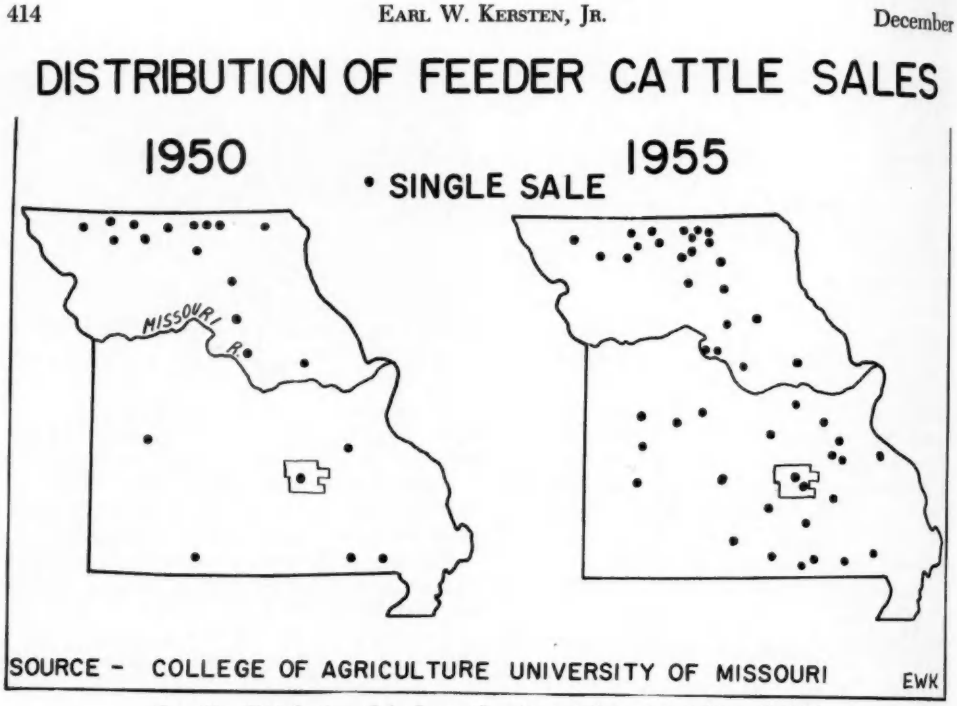

FIG. 16. Distribution of feeder cattle sales in Missouri in 1950 and 1955.

markets in 1955 offered nearly half of the total number of feeder cattle placed on sale in the state.[38]

Recent increases in the size of farms and in the extent of improved land on farms favor the future success of agriculture. Since 1930, the number of farms has declined and the average size of farms has increased. This occurred because farmers left the land and the remaining farms were consolidated. Census reports show that Meramec Township had 65 farms in 1930 and only 58 in 1950. The number in Osage Township declined from 127 to 111 during the same period. The average size of farms in Meramec, Osage, and Linn townships increased between 1930 and 1950. For example, farms in Linn Township averaged 191 acres in 1930, and 249 acres two decades later. Little change occurred in the farm units in Sinking Township between 1930 and 1950.

Although some increases have occurred in the extent of improved land on farms as a result of the clearing of farm woodlands, productive farm land is still limited in area; as a result, small-scale farm operations are the rule. Generally, less than half of the typical 200-acre holding is cleared land. Moreover, only part of the improved acreage on most farms is productive bottomland; the remainder consists of hillside pastures. Only modest returns come from farms such as these. To achieve greater income, it is necessary that agricultural units be further enlarged and methods further improved.

A recent economic development that is most surprising is the strong revival of mining. The leading mining area of the eastern and central Ozarks for 150 years has been the St. François Knob and Basin region (Fig. 1), with lead and iron the chief products. As discussed previously, small "filled sink" iron deposits were mined in the Courtois Hills and vicinity during the 19th and early 20th centuries. Since World War II, intensive geological and geophysical prospecting has been carried on in this region. As a result of this search, large and valuable lead and iron deposits were discovered.

In the fall of 1957, the St. Joseph Lead Company, which is the major producer of lead in the St. François region, began active devel-

[38] Agricultural Extension Service, Dent County, *loc. cit.*

TABLE 3.—POPULATION TRENDS IN SELECTED PORTIONS OF DENT COUNTY, 1930–50[1]

Area	Population			
	Total			Percentage Change
	1930	1940	1950	1930–50
Dent County	10,974	11,763	10,936	—1
Eastern Dent County (four National Forest townships)	2,123	1,920	1,306	—38
Remaining rural townships of county[2]	5,257	5,264	4,385	—17
Salem	2,250	3,151	3,611	+60

[1] Based on census data.
[2] Total of county less eastern Dent County townships and Spring Creek Township with town of Salem.

opment of a large lead deposit near Viburnum, only a few miles northeast of Osage Township, Dent County. This and other deposits form a new lead district in which development costs may reach $15,000,000.[39]

Pea Ridge in northern Crawford County is the site of a recently discovered iron deposit which, when fully developed, will be the largest producer in the history of Missouri. Development was under way in the spring of 1958, and initial production was planned for 1962.[40]

Significant population adjustments have taken place in recent years (Table 3). The eastern townships of Dent County declined rapidly in population between 1930 and 1950, while other rural areas of the county lost population more slowly; at the same time, the growth of Salem nearly balanced rural losses.

The upland inhabitants of eastern Dent County have virtually disappeared. As indicated by the distribution of abandoned houses (Fig. 13), many people have migrated from the smaller tributary valleys where submarginal farms have been common. The result of these changes is the localization of the population primarily in the larger valleys. At a few points where major roads intersect, small agglomerations, such as Bunker, Howes Mill, Stone Hill, and Turtle (Fig. 13) exist. Although some improvements have been made in the main routes in recent years, secondary roads serving the valleys are still generally poor.

Salem has long been the leading town in the large rugged, sparsely settled area between Rolla in the north central Ozarks and Poplar Bluff on the southeast border of the highland. Salem's commercial interests extended to much of this large area as major road improvements were carried out by the state in the 1930's and 1940's. Lumber processing and local industries were the only important manufacturing activities of Salem until 1927. In that year the Ely-Walker Company, a St. Louis-centered clothing manufacturing firm, established a plant in Salem. Recently this factory was closed. The building was purchased by a corporation organized by the townspeople and leased to another clothing manufacturer.[41] In 1948, a shoe factory was established in Salem. This plant is one of several in eastern Missouri owned by the International Shoe Company. In 1954, a second clothing factory moved here. The major factor that has been responsible for the migration of these industries to Salem is the reservoir of low-cost labor in the town and nearby rural areas. The relatively low living costs here, the wide range of services available in Salem and the town's attractive appearance are other factors favoring industrial growth. Quite important too has been the strong community interest in attracting industry and in retaining those factories which are located in the town.

Salem's development has also followed other directions. The Missouri Conservation Commission recently established its maintenance headquarters here. Under construction in the spring of 1958 were a new high school, a new National Guard Armory, a 15-acre park, and a light aircraft landing field.[42]

Little development in tourism and resorts has occurred in the past. Nevertheless, there is an important potential for these activities. Dent County has a favorable situation for the tourist business because of its position between the scenic and historic central Meramec Valley and the famous Big Springs country of the southern Courtois Hills.[43] The

[39] "St. Joe Developing Second Major Missouri Lead Belt," *Mining World*, Vol. 20 (May 1958), p. 35.
[40] *Ibid.*
[41] Joe Ewing, Secretary, Dent County Rural Development Committee, Salem, Missouri, letters dated November 13, 1957, and May 9, 1958.
[42] *Ibid.*
[43] The scenic attractions of these and other areas of the state are described in the Recreation Booklet series and other publications of the Missouri State Division of Resources and Development, Jefferson City, Missouri. Also, see Robert M. Crisler, "Recreation Regions of Missouri," *Journal of Geography*, Vol. 51 (1952), pp. 30–39.

chief resort attraction in Dent County is Montauk State Park, at the site of Montauk Spring, about 20 miles southwest of Salem. The state carried out a large expansion of the park's facilities during the spring of 1958.[44]

THE COURTOIS HILLS

The region of which eastern Dent County is representative is the Courtois Hills area, which is the core of the eastern Missouri Ozark Highland. The Courtois Hills are the largest remaining bloc of extensively forested land in the Ozark Highland of Missouri (Fig. 17). Census reports for 1954 show that only 30 to 40 percent of the land of this region is in farms. About two-fifths of the farmland is cleared. These proportions have remained much the same for decades, indicating that little land suitable for farming remains in forest.

Economic life in the Courtois Hills and adjacent country, as in eastern Dent County, is based upon forestry, stock-raising, mining, recreation, and the commercial and manufactural functions of towns.

Forestry has great potential for future development but much depends upon the policies and actions of private forest owners, who control about three-fourths of the forest land. Clark National Forest includes most of the remainder. Scientific forestry has been practiced for years on the Shannon County lands of a large liquor distilling concern; here, oak for whiskey barrels is produced under a sustained-yield plan. Throughout the Courtois Hills, federal, state, and county forestry specialists are at work making known the advantages of sound forest management practices.

Agriculture, though hampered by limited areas of productive land, has made remarkable progress recently in the Courtois upland. Pastures and hay have largely supplanted grains on valley farms. Feeder calves have become an important specialty throughout these hills. Sales of feeder cattle are held regularly at such towns as West Plains in Howell County, Birch Tree in Shannon County, Doniphan in Ripley County, Ellington in Reynolds County, and Potosi in Washington County (Fig. 17).

The new lead and iron discoveries in the Courtois Hills promise to boost this area into a prominent position in mining. Towns accessible to the lead deposits of the central Courtois Hills, such as Steelville, Potosi, and Salem, should benefit from the new mining activities. Sullivan in the northern Courtois Hills is the center which will be most strongly affected by the Pea Ridge iron development.

Resort activities and tourism in the Courtois Hills have been hampered by isolation and lack of promotion. Recently, extensive road improvements have opened up the region. Seven state parks as well as Clark National Forest are located in this region. It seems certain that recreation will increase in importance in these scenic hills, located only a few dozen miles from the St. Louis urbanized area.

The rugged Courtois Hills have discouraged urban growth, but significant towns adjoin the upland where major routes skirt its edges (Fig. 17). Rolla, Cuba, and Sullivan are located on a route followed by the St. Louis and San Francisco Railroad and U. S. Highway 66 along the northern edge. Located on the Missouri Pacific Railroad which passes along the eastern border are Potosi, Ironton, and Poplar Bluff. West Plains and Salem are near the western margin.

Traditionally these towns have served not only the areas in which they are located but also the adjoining rugged hills. They process the lumber and auction the cattle of the Courtois region. They also provide the supplies needed by the people of the hills. Many citizens of these towns have come from the farms and logging camps of the Courtois Hills.

Industry has migrated to many towns in or adjoining the Courtois Hills, as it has in the case of Salem. Shoe and clothing factories have moved in, attracted by favorable labor conditions. It is the rural areas of the Courtois Hills which supply much of the labor for the new industries. Shoe factories are located at Rolla, Potosi, Steelville, Cuba, Sullivan, and Poplar Bluff. Clothing is manufactured at Bourbon and St. James. The larger towns have more varied interests, i.e., Poplar Bluff (population 15,064 in 1950) and Rolla (9,354 in 1950) are both important railroad centers. The latter is also the home of the Missouri School of Mines and the site of federal and state offices.

CONCLUSION

1. The retarded economy of the interior Ozarks, so often referred to in the literature,

[44] Information supplied by Dent County Rural Development Committee.

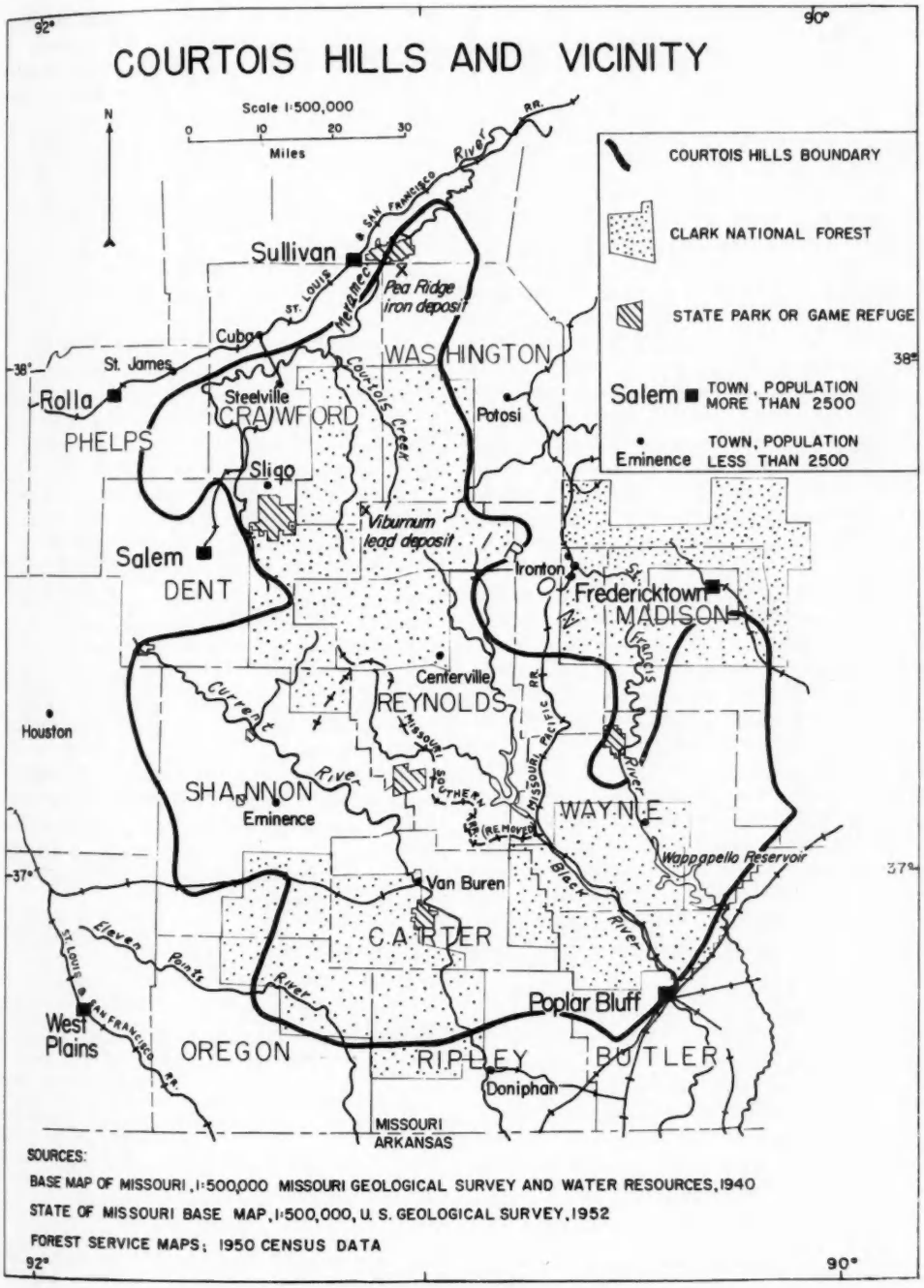

FIG. 17. Map of the Courtois Hills and vicinity.

is attributable mainly to the meagerness of natural resources. Although isolation has been involved, it is not the major cause for the long persistence of a frontier or pseudo-frontier way of life. The limited resources of the upland became exhausted quickly, forcing people to shift occupations or to combine several activities; seldom have resources been rich enough for a single pursuit to become dominant. Where this has occurred, as in the case of productive soils and gentle slopes in the Springfield Plateau of southwest Missouri, or the lead deposits of the St. François region, economic growth compares favorably with many lowland areas of the Midwest.

2. The Courtois Hills and nearby areas are nearing economic maturity after decades of backwardness. Agriculture and forestry promise to reach a position of permanent productivity. There is increasing acceptance in the region of the concept of conservation and the need for sound management of natural resources. The late and potentially large revival of mining will substantially bolster Courtois economy in coming years. The recreation industry and manufacturing, the newest activities to achieve significance, may prove to be the key to future prosperity. Interestingly, neither of these activities is primarily dependent upon the natural endowments of the land in which they are located. Although resorts and tourism thrive upon fine scenery and other natural attractions, the great advantage of the Courtois Hills for recreational growth is their accessibility to St. Louis and other large Midwest urban concentrations. Industry has migrated here not because of local natural resources, but because of labor conditions. Surplus labor, once a regional problem, has become an asset. Too, the nearness of these towns to St. Louis, headquarters of their factories, has made them desirable as industrial sites. These facts indicate that the location of the Ozarks, a centralized position in the United States adjoining regions of growing urban populations, may prove to be one of its outstanding advantages for future economic growth.

3. The facts of rural decline and town growth in the eastern interior Ozarks cannot be dismissed lightly. Though some net decline in population is occurring, urbanization is the end result. The Ozark Highland has fewer cities and towns than nearby heavily populated lowlands but its population in each succeeding year becomes more concentrated in urban places and less so in rural areas. This trend brings to mind the quotation by Aurousseau[45] of Alexander Woeikof's comments on the small town as a rural settlement form:

> Small towns are found in regions where the soil is very poor or restricted in extent; in oases, where irrigation is necessary for agriculture; and where defense is the prime necessity. As an instance of the first case, we may take the country around Moscow, where the soil is so wretched—sandy or marshy — that rural industries entirely supplant agriculture and the whole population of the region has grouped itself into a number of small towns and villages.

Population and settlement shifts taking place in the Ozarks will probably be arrested before reaching the extreme condition just described. Nevertheless, Ozark towns are certain in the future to play an increasingly important economic role.

[45] See: "The Arrangement of Rural Populations," *Geographical Review*, Vol. 10 (1920), p. 224.

DAR ES SALAAM, THE PORT AND ITS TRIBUTARY AREA[1]

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Columbia University

DAR ES SALAAM has long been an important ocean gateway of Tanganyika and an accessory transit point for traffic of the eastern Congo and Ruanda-Urundi. Its trade remained at a low level, however, for many years. Particularly in the thirties the port suffered severe economic distress, because Belgian policies favoring use of the national routes of the Congo, plus competition from Lobito and Beira,[2] prevented achieving levels in transit traffic hoped for at the time of construction. Also, the economy of the domestic tributary area was slow to develop.

In postwar years, Dar es Salaam has shared the boom characterizing most African seaports. Cargo movements increased from 188,769 harbor tons[3] in 1938 to 996,426 tons in 1956, resulting in repeated grievous congestion. Successive improvements of handling facilities became imperative, but the terminal remained a lighterage port until November, 1956, when the deepwater Princess Margaret Quay was opened.

This article examines briefly the physical characteristics of Dar es Salaam harbor, the trade structure of the port, its main connections with the interior, and the component parts of its national and extra-national tributary area.

POSITION OF DAR ES SALAAM IN EAST AFRICAN TRANSPORT

Since 1949 the heavy transportation facilities of Kenya, Uganda, and Tanganyika have been combined under the East African Railways and Harbours (E. A. R. and H.) Administration, making the port of Dar es Salaam relevant to the whole British East African transport complex.[4] Table 1 compares the traffic on the East African railways and at their coastal termini, showing that Dar es Salaam rates well below Mombasa, the Kenya and Uganda port, in cargo handled, though it has made a considerable relative gain since 1938. The disparity between the two ports in number and tonnage of ships calling is not so marked, partly because of the smaller size of vessels serving Dar es Salaam and partly because both ports are regular stops on numerous liner services.

With an area of 362,688 square miles and an estimated population of 8,456,000 (1956), Tanganyika ranks first in size and population among British East African territories. Economically, however, it has been the Cinderella of the area, which explains its lower traffic levels. Nor is there the same concentration upon one port that characterizes Kenya and Uganda. Tanganyikan trade moves through Tanga in the north, Dar es Salaam in the center, and Lindi and Mtwara in the south, while much traffic of the Northeastern Highlands and the Lake Victoria shores of Tanganyika follows the road to Mombasa.

DAR ES SALAAM HARBOR

From the standpoint of navigation, the site of Dar es Salaam rates only fair. Access to the constricted inner harbor (about ½ square mile in area) requires pilotage through a narrow, angular channel obstructed by the littoral coral growth (Fig. 1). Ship movements are further hindered by several shoals and periodic strong tidal currents in the entrance. Vessels exceeding 20,000 gross tons or a length of 600 feet must anchor in the outer bay and be lightered over a considerable distance to the quays. The mouth of Southern Creek, how-

[1] This article is seventh in a series on ports of middle Africa prepared under a Columbia University contract with the U. S. Office of Naval Research, Geography Branch. The cooperation of many people in the United States, United Kingdom, and Africa, and particularly of the East African Railways and Harbours Administration, is gratefully acknowledged.

[2] Regarding routes of access to interior central Africa, see Fig. 7 and p. 466 in W. A. Hance and I. S. van Dongen, "The Port of Lobito and the Benguela Railway," *Geographical Review*, October 1956, pp. 460–87, and their "Matadi, Focus of Belgian African Transport," *Annals*, Association of American Geographers, March 1958, pp. 41–72, for the present division of Belgian Katanga's traffic among its various gateways.

[3] A harbor ton at East African seaports is a special unit of measurement either by weight (2,240 lbs.) or by cubic capacity (40 cu. ft.), whichever is greater.

[4] Prior to amalgamation there were two state-owned organizations, one for Kenya–Uganda and one for Tanganyika. For a detailed study of the regional transport framework see I. S. van Dongen, *The British East African Transport Complex*, University of Chicago, Dept. of Geography, Research Monograph No. 38 (University of Chicago Press, 1954), 172 pp.

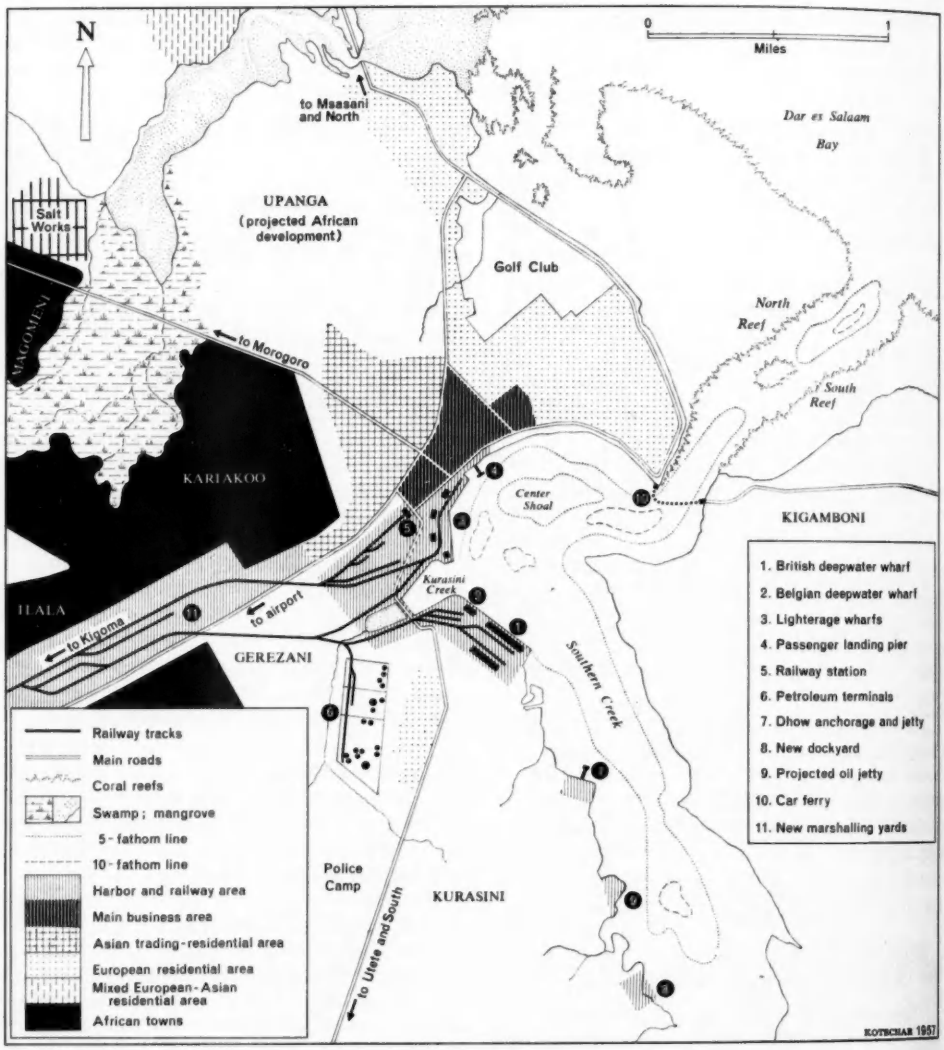


FIG. 1. Dar es Salaam harbor and city.

ever, can serve as an extension to the main basin, and the new deepwater port (Fig. 2) is on partly reclaimed land at its northeastern edge. Kurasini Creek runs dry at low water and is used only by small craft and for mooring lighters.

Unlike centuries-old Mombasa, the port of Dar es Salaam has developed entirely within the period of European colonization. Prior to German occupation of that part of Africa in 1890, the Arabs shipped slaves to Zanzibar via Bagamoyo, 44 miles to the north. Medieval Persian and Arab navigators chiefly knew Kilwa Kisiwani, to the south.

A primitive jetty for handling railway construction materials was erected by the Germans at Dar es Salaam in 1905. A concrete lighterage quay and a passenger landing were added by the British in interwar years, and plans were made for a deepwater port, but a decline in trade prevented their adoption. After World War II, the rise in traffic urgently

TABLE 1.—COMPARATIVE TRAFFIC AT EAST AFRICAN OCEAN HEADS AND ON THEIR FEEDING LINES FOR 1938 AND 1956[1]

	Year	Mombasa[2]	Dar es Salaam	Tanga	Lindi	Mtwara[3]
Cargo handled ('000 harbor tons)[4]	1938	1,898	189	135	n.a.	—
	1956	3,204	996	328	53	95
Number of ships calling	1938	711	707	604	140	—
	1956	1,233	911	611	113	119
Net registered tonnage of ships calling ('000 tons)	1938	2,254	1,710	942	221	—
	1956	3,840	2,783	1,840	145	262
Hauled on feeder rail lines ('000 long tons)	1938	1,796[5]	138[6]	93	n.a.	—
	1956	4,207	872[7]	407	— [8]	87

[1] Sources: 1938—Kenya and Uganda Railways and Harbours, *Report of the General Manager . . . for the year ended 31st December 1938* (Nairobi: Government Printer, 1939), pp. 14 and 56–57; Tanganyika Railways and Ports Services, *Report of the General Manager . . . for the year ended 31st December 1938* (Dar es Salaam: Government Printer, 1939), p. 24. 1956—East African Railways and Harbours, *Annual Report 1956* (Nairobi: Government Printer, 1957), pp. 11 and 61.

[2] Kilindini deepwater port and Mombasa old port combined.

[3] Mtwara deepwater port was opened in 1954; Mtwara-Nachingwea line began operations in 1955.

[4] A harbor ton at East African seaports is a special unit of measurement either by weight (2,240 lbs.) or by cubic capacity (40 cu. ft.), whichever is greater.

[5] Paying traffic 1,130 thousand; service traffic 666 thousand.

[6] Public traffic only.

[7] Public traffic 568 thousand; service traffic 304 thousand.

[8] Lindi had a tramway feeder in prewar years; in 1949–55 a temporary rail connection from Lindi–Mkwaya to Ruo on the Mtwara–Nachingwea line was under construction.

East African Railways and Harbours

FIG. 2. Dar es Salaam's deepwater quay under construction (in center). A portion of the lighterage quays is seen in the foreground. Kurasini Creek is at the center right, the entrance to Southern Creek at the left.

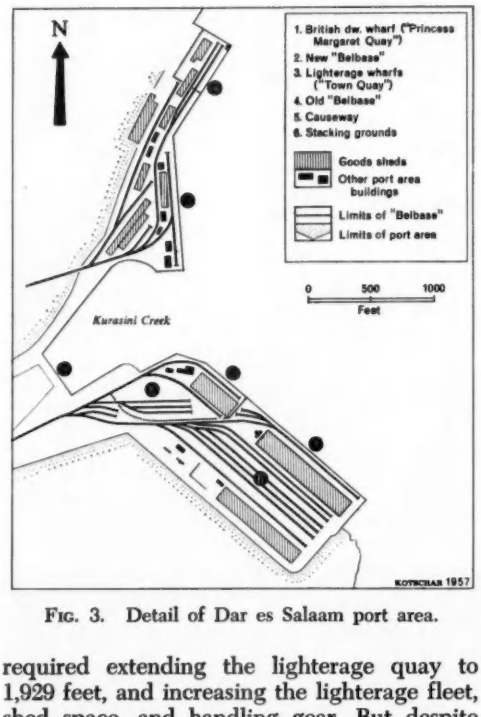


FIG. 3. Detail of Dar es Salaam port area.

required extending the lighterage quay to 1,929 feet, and increasing the lighterage fleet, shed space, and handling gear. But despite exceptional performances at the wharves (Fig. 3) port operations still suffered greatly from inadequate storage space and rolling stock.

Construction of the $12.6 million Princess Margaret Quay was begun in 1951. Now its 1,824 feet offer accommodation to three ocean-going vessels of 30-foot draught. The quay has two large front sheds, modern cranage, extensive stacking grounds and rail trackage,[5] and brings the present handling capacity of the port to 1.5–1.6 million harbor tons a year. Berths 2 and 3 belong to E. A. R. & H.; berth 1 is the new "Belbase," the traditional Belgian customs-free enclave.

If the estimates of the Economist Intelligence Unit prove correct—that exports via Tanganyikan ports would increase only 2.5 percent and imports 3.5 percent yearly in the next decade—there is a comfortable margin between port traffic and capacity for some time ahead.[6] But plans have already been prepared for two additional deepwater berths. The port's most pressing short-term need is being met by the construction of a jetty for bulk unloading of petroleum products, which is still being done through a floating pipe. Dar es Salaam received fuels by coastal tankers from the entrepôt at Mombasa until 1950, when tanks were installed near the wharves (see Fig. 1) to supply both the domestic and extra-national hinterlands.

TABLE 2.—DAR ES SALAAM TRAFFIC, 1938, 1948, 1956[1]
(Goods in harbor tons[2])

Type of traffic	1938	1948	1956
Goods Traffic			
Imports	91,358	333,169	595,733
General cargo	91,358[3]	308,933	395,071
Coal	—	—	4,329
Bulk oil	—	24,098	196,333
Exports	97,411	170,778	378,885
General	97,411[3]	168,684	377,980
Bunkers and bulk oil	n.a.	2,094	905
Transshipments	n.a.	149	21,808
Passenger traffic	n.a.	n.a.	39,252
Passengers embarked	n.a.	n.a.	20,403
Passengers disembarked	n.a.	n.a.	18,849

[1] Sources: Same as Table 1.
[2] A harbor ton at East African ports is a special unit of measurement either by weight (2,240 lbs.) or by cubic capacity (40 cu. ft.), whichever is greater.
[3] Including transshipments.

STRUCTURE OF PORT TRADE

Table 2 gives a comparative picture of goods and passenger movements in 1938, 1948, and 1956, showing the fivefold increase in cargo handled since pre-World War II. The prewar dominance of exports has also been reversed, largely due to substantial import of capital goods for territorial development.[7]

Table 3 lists the commodities shipped from Dar es Salaam in 1956, a typical year from the standpoint of the range of port trade, dominated as usual by sisal and cotton, but with an unusually large export of maize. Sisal has accounted in postwar years for 40 to 55 percent of the value of Tanganyika's exports, but Dar es Salaam ranks below Tanga in its shipment, over half of the acreage under sisal being in the latter port's tributary area. Despite

[5] See "The Port of Dar es Salaam: Completion of the New Ocean Terminal for Tanganyika," *Dock and Harbour Authority*, Vol. 37 (Nov. 1956), pp. 215–18.
[6] East African Railways and Harbours, *The Economy of East Africa: A Study of Trends* (Nairobi, 1956), pp. 206–22, 232.
[7] See: Tanganyika Territory, *A Ten-year Development and Welfare Plan for Tanganyika Territory—Report* (1946); *Revised Development and Welfare Plan for Tanganyika, 1950–1956* (1951); *Development Plan 1955–1960 — Capital Works Programme* (1955).

TABLE 3.—EXPORTS THROUGH DAR ES SALAAM, 1956[1]

Commodity	Harbor tons	Percent of total
Sisal	79,887	21.1
Cotton fiber	48,399	12.8
Cottonseed	2,900	0.8
Peanuts (unshelled)	9,500	2.5
Copra and cake	2,891	0.8
Other oilseeds and cake	46,647	12.3
Maize	65,431	17.3
Rice	1,818	0.5
Coffee	14,415	3.8
Tea	3,375	0.9
Cashew nuts	3,346	0.9
Pyrethrum	1.264	0.3
Hides and skins	7,135	1.9
Beeswax and gum	2,897	0.8
Timber	3,340	0.9
Lead concentrates	14,142	3.7
Metal containers (oil cases and drums)	12,546	3.3
Other	58,952	15.6
Total	378,885	100

[1] Source: E. A. R. & H. administration records.

lower prices since 1952, the volume of sisal exports continues to increase.[8]

Among minerals obtained in the territory, only lead concentrates, produced at Mpanda since 1950, figure significantly at the port. Diamonds and gold, the leading domestic mineral exports by value, are largely shipped overseas by air. Imports at Dar es Salaam are mostly general cargo, with heavy machinery and cement ranking high. The only import in bulk is petroleum fuels.

Practically all coffee exported is transit cargo from Belgian Africa. The valuable coffee exports (some 10,000 long tons a year) from African farms in the Bukoba area of Tanganyika, potentially tributary to Dar es Salaam, are drawn via Lake Victoria to the Kenya route, the only one on which suitable marketing and curing facilities are available. Belgian Africa also ships out via Tanganyika some castor seed, hides and skins, pyrethrum, essential oils, and a trickle of minerals. As much as one-third of transit imports is petroleum products, another third is metal manufactures and cement, and the remainder is miscellaneous goods.

The volume of Belgian African transit flow has varied greatly since the route to Dar es Salaam over Lake Tanganyika and the Central Railway was opened in 1914, despite the inducement of low freight rates and the existence of customs-free "Belbases" at the lake and ocean termini. In 1931, before completion of the link to Lobito, copper from Katanga supplied half of the Central Railway's freight revenue, but by 1938 total transit volume had fallen below 7,000 long tons. A record of 89,000 long tons was reached in 1954, but closing of the Suez Canal lowered the tonnage to 66,000 in 1956. It is hoped that the new deepwater quay will prove an incentive for increased Belgian African shipments and that a more favorable balance between inward and outward movements will be established. At present, inward transit flow is twice the seaward transit traffic.

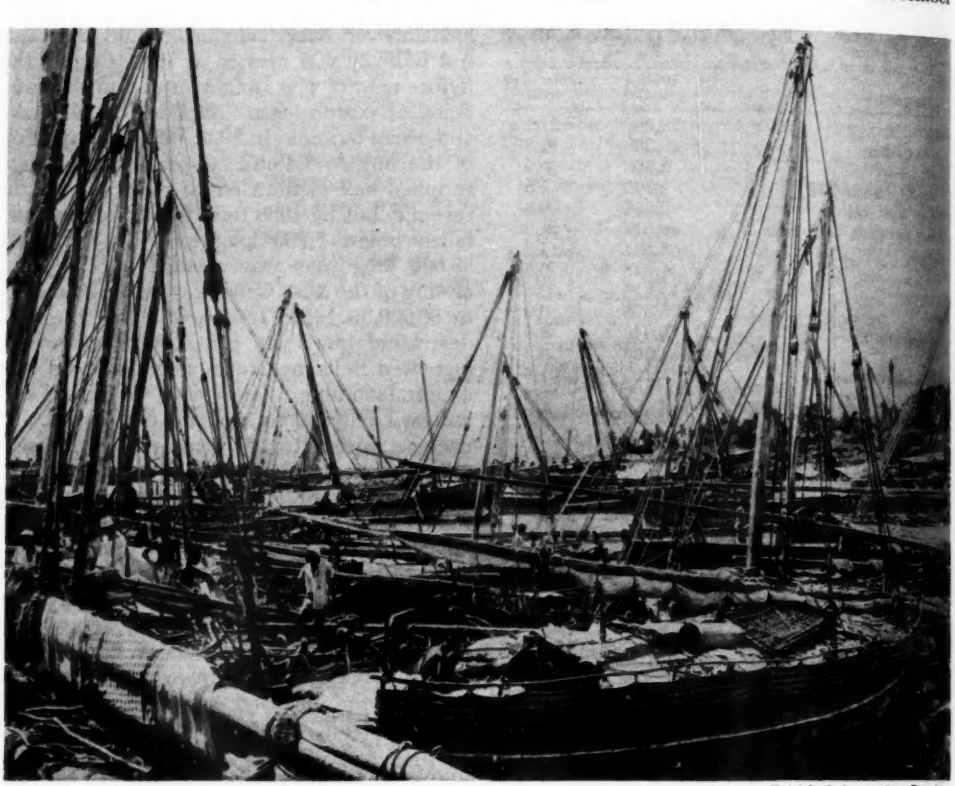
Overseas trade accounts customarily for 85 to 90 percent of port cargo handled at Dar es Salaam. But in a typical year, more than a third of recorded ship entries are by coasting vessels, and there are a large number of unrecorded entries by sailing ships. The latter include large Arab and Persian dhows navigating between East Africa and Asia on the wings of the monsoon as in the days before European rule. These vessels are served at a small dhow jetty built in 1949 (Fig. 4). Coasting vessels also account for 60 to 65 percent of passenger traffic, reflecting intense movement to and from Zanzibar and Pemba, particularly at clove harvest time.

British-flag ships account for 40 percent of net registered tonnage (exclusive of tankers) entering Dar es Salaam, and about half of cargo loaded and unloaded. The Netherlands, France, and the United States follow. About half of transit cargo is handled by Belgian vessels. That nation runs a special schedule via the Suez to the east African seaboard, with Beira as terminus, to collect transit shipments from Belgian Africa at extra-national gateways.

THE TOWN

Dar es Salaam began in 1889 as a small German garrison town on the site of a decayed Arab fishing hamlet. It soon became the administrative center of German East Africa and remained the capital of Tanganyika under British mandate (Fig. 5). Today the town has a strong Afro-Asian flavor as Indians, Arabs, Pakistanis, and Goans com-

[8] On sisal in Tanganyika, see J. F. R. Hill and J. P. Moffett, *Tanganyika, A Review of Its Resources and Their Development* (Dar es Salaam: Government of Tanganyika, 1955), pp. 420–55.



British Information Services

FIG. 4. Dhow anchorage in the port of Dar es Salaam. The craft in the foreground engage in local coasting; in the center background are some Arabian ocean-going dhows.

prise over 30 percent of the total population of about 100,000. Most of the 4,000 Europeans are in government service.

The town performs an important commercial function by minutely sifting imported goods before they are distributed to the interior. Outbound domestic produce is less intercepted because several growers' associations arrange for direct shipment overseas.

Dar es Salaam is also the only manufacturing center of significance in Tanganyika. Until recently, industry was restricted to milling (wheat, rice, edible oils), soap making, brewing, and repair shops. The first sizable exporting of meat started in 1950 with the erection of the Tanganyika Packers, Ltd., plant at Msasani Bay, now processing 50–60 thousand head of cattle and exporting annually some 3,000 long tons of meat products, plus hides and skins. The manufacture of metal containers followed. Other plants, concerned primarily with the domestic market, produce oxy-acetylene, paints and varnishes, and fiber rugs. For the future, plans call for a larger flour mill, a cement plant, a tobacco factory, a Bata shoe factory, and a cotton blanket factory.

PORT FEEDERS

The Central Tanganyika Rail System

The Central Tanganyika Railway is the principal distributor and collector of freight passing through Dar es Salaam. It is a meter-gauge, single-track system with a total length of 1,283 miles. The main line, constructed by the Germans in 1905–14, runs 780 miles to Kigoma (Fig. 6), climbing to a maximum elevation of 5,100 feet before it drops to 2,515 feet at Lake Tanganyika. The railroad was not conceived to promote any specific regional development, but simply followed the former Arab slave-caravan trail. In 1924–28, a 237-

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FIG. 5. A section of Dar es Salaam with the entrance channel to the inner harbor, as seen from the air. The multi-storied buildings in the foreground are largely within the Asian trading–residential area.

mile branch was laid from Tabora to Mwanza to serve the populous and relatively rich lands around Lake Victoria, and in 1949–50, a 131-mile line was added to tap the Mpanda mineral complex. Several short branches which existed at one time were later lifted because of insufficient traffic.

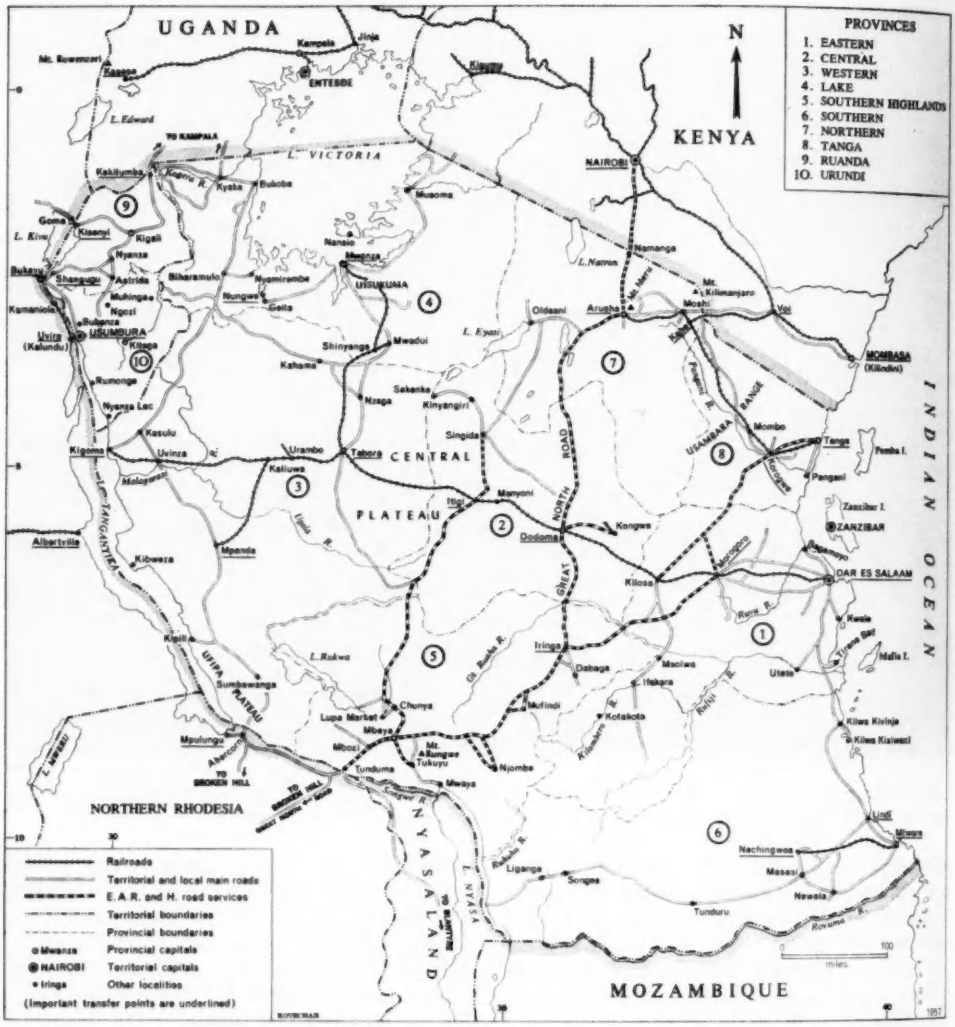
Physical difficulties besetting the Central Railway are numerous. The line runs across the natural grain of the country, increasing the difficulties and expenses of maintenance and operation. It traverses for the most part semiarid country where recurrent droughts require dispatching water and "famine" trains. Washouts commonly interrupt traffic in the short rainy season. The indirect influence of the environment, however, is even more significant, for the low-productive character of most of the hinterland is not conducive to a heavy traffic offering.

Before the war, the Central Railway never covered its operating expenses,[9] the public traffic movement in 1938 totalling only 138,032 long tons. With accelerated postwar development the total tonnage transported rose by 1956 to 872,202 long tons and the total ton-mileage to 300 million, the average haul being twice that of prewar years.[10] The great increase in traffic found the Central Railway completely unprepared, and a main cause of congestion in the port was inability of the railway to clear the backlog of goods at the wharves or upcountry.

Following amalgamation of the Central

[9] See J. R. Farquharson, *Tanganyika Transport: A Review* (Dar es Salaam: Government Printer, 1945), 96 pp.

[10] Prewar data from Tanganyika Railways and Port Services, *Report of the General Manager on the Administration of the Railways and Port Services for the Year Ended 31st December, 1938* (Dar es Salaam: Government Printer, 1938), p. 24; 1956 figures, courtesy E. A. R. & H.


UGANDA
KENYA
N
PROVINCES
1. EASTERN
2. CENTRAL
3. WESTERN
4. LAKE
5. SOUTHERN HIGHLANDS
6. SOUTHERN
7. NORTHERN
8. TANGA
9. RUANDA
10. URUNDI
L. VICTORIA
L. Edward
L. Kivu
L. Eyasi
L. Rukwa
L. Nyasa
L. Natron
L. Amboseli
L. Jipe
L. Chala
L. Lufiji
NAIROBI
ENTEBBE
KAMPALA
MOMBASA
ZANZIBAR
DAR ES SALAAM
Mt. Kilimanjaro
Mt. Elgon
Mt. Meru
Mt. Rungwe
Mt. Tukuyu
Mt. Rwenzori
Albertville
Broken Hill
Bukoba
Musoma
Mwanza
Shinyanga
Tabora
Kigoma
Dodoma
Iringa
Mbeya
Tunduma
Njombe
Arusha
Moshi
Tanga
Pemba I.
Zanzibar I.
Mafia I.
Kilwa Kivinje
Kilwa Kisiwani
Lindi
Mtwara
Nachingwea
Masasi
Newala
Tunduru
Songea
Liganga
Mahenge
Kilosa
Morogoro
Kibaha
Utete
Ifakara
Mlimba
Mikumi
Kondoa
Singida
Kahama
Geita
Nzega
Sekenke
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Mwadui
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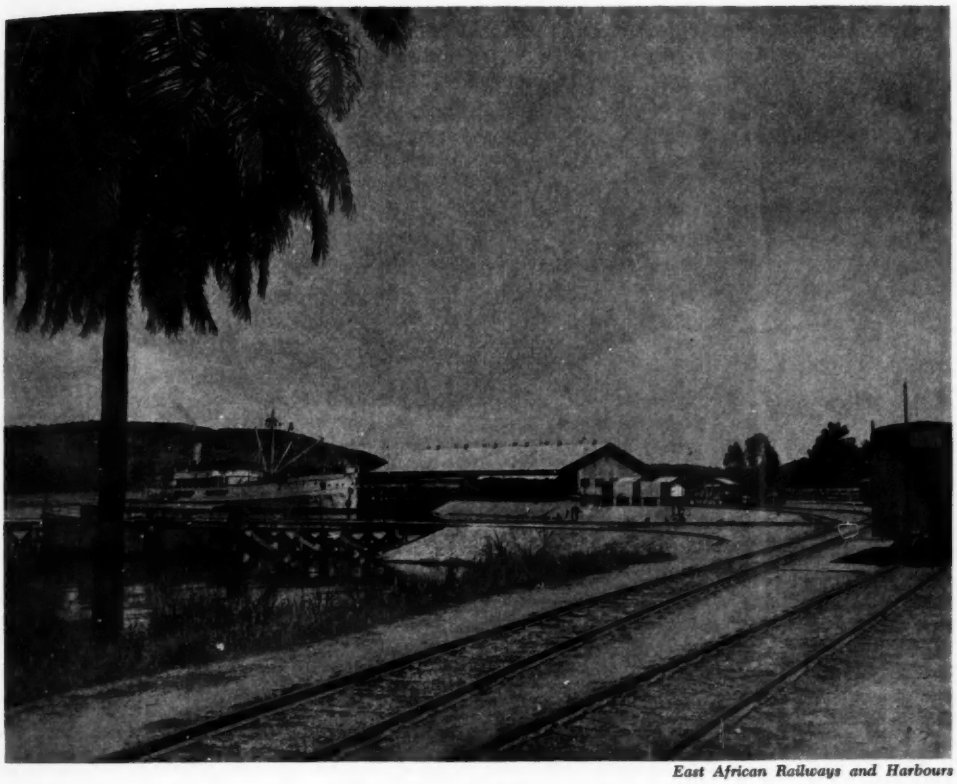
Bunda
Musoma
Nansio
Ukerewe I.
Kisumu
Kericho
Nakuru
Eldoret
Oldeani
Mbulu
Kondoa
Irangi
Kasulu
Kibondo
Kigoma
Uvinza
Urambo
Kaliuwa
Manyoni
Itigi
Mpanda
Kibwesa
Malagarasi
Kigoma
Rumonge
Nyanza Lac
Ngozi
Kitega
Usumbura
Bujumbura
Uvira
(Kalundu)
Kamaniola
Shangugu
Astrida
Muhinga
Kigali
Nyanza
Kisenyi
Gisenyi
Goma
Kakitumba
Kagera R.
Kyaka
Bukoba
Biharamulo
Nyamirembe
Nungwe
USUKUMA



East African Railways and Harbours

FIG. 7. Mwanza, the main Tanganyikan port on Lake Victoria and terminus of the Tabora–Mwanza branch rail line.

Road and Lake Feeders of the Central Tanganyika Line

Supplementing the rail line are a number of long distance truck and bus connections operated by E. A. R. & H. The most important of these are the Dodoma–Mbeya route covering some 406 miles of the Great North Road (an important link between British East and Central Africa), the 304-mile Itigi–Mbeya route, and the 178-mile Morogoro–Korogwe route linking the Central and Northern rail systems (see Fig. 6). About 63,000 long tons were lifted in 1956 by these and the less important motor services.

E. A. R. & H. steamer and barge services on Lake Victoria do not contribute as much as they might to shipments at Dar es Salaam, partly because most of the overseas lake traffic moves via Kisumu in Kenya, which bases a superior fleet, and partly because the northern and western shores of the lake are more productive than the southern.[11] However, new lake craft were introduced in 1955 at Mwanza (Fig. 7), the Tanganyika lake base, and they contributed to increasing that port's trade to 94,000 long tons in 1956. About 70 percent of this tonnage was shipped to and from Dar es Salaam. The proposed new port at Mwanza South may result in further growth in regional freight movements via Tanganyika.

Kigoma, the Central Railway's terminus on Lake Tanganyika, is even more important than the Mwanza head to Dar es Salaam. Practically all of its trade of 75,000–90,000 long tons a year passes through that ocean terminal. All Belgian African transit traffic through Tanganyika funnels through Kigoma, plus a small tonnage of goods to and from

[11] See V. C. R. Ford, *The Trade of Lake Victoria, A Geographical Study* (Kampala: E. A. Inst. Soc. Res., 1955), 66 pp.

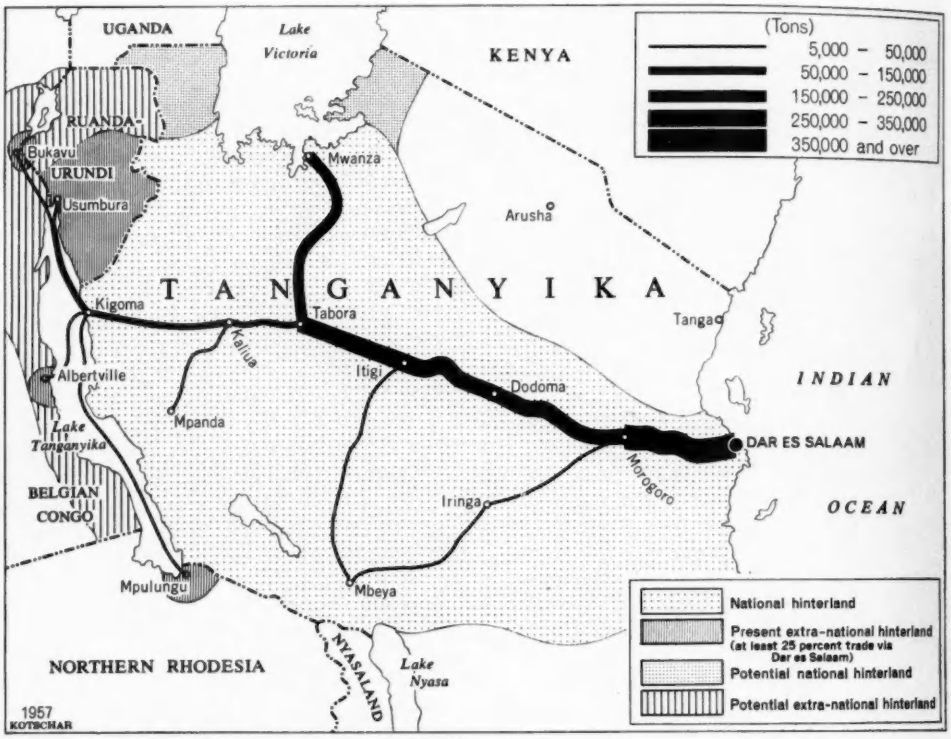


FIG. 8. National and extra-national hinterlands of Dar es Salaam together with traffic densities on the major rail, road, and lake feeders.

Northern Rhodesia moving via the tiny port of Mpulungu at the southern end of the lake. Belgian traffic is carried exclusively by C. F. L. (Compagnie du Congo Supérieur aux Grands Lacs Africains),[12] while E. A. R. & H. steamers handle traffic along the Tanganyikan and Northern Rhodesian shores (8,000 long tons in 1956). The "Belbase" at Kigoma, with a 672-foot quay, substantial storage space, and cranes of 3- to 25-ton capacity, is the most important part of Kigoma port. The British quay is only 275 feet in length.

Coastwise Shipping and Air Connections

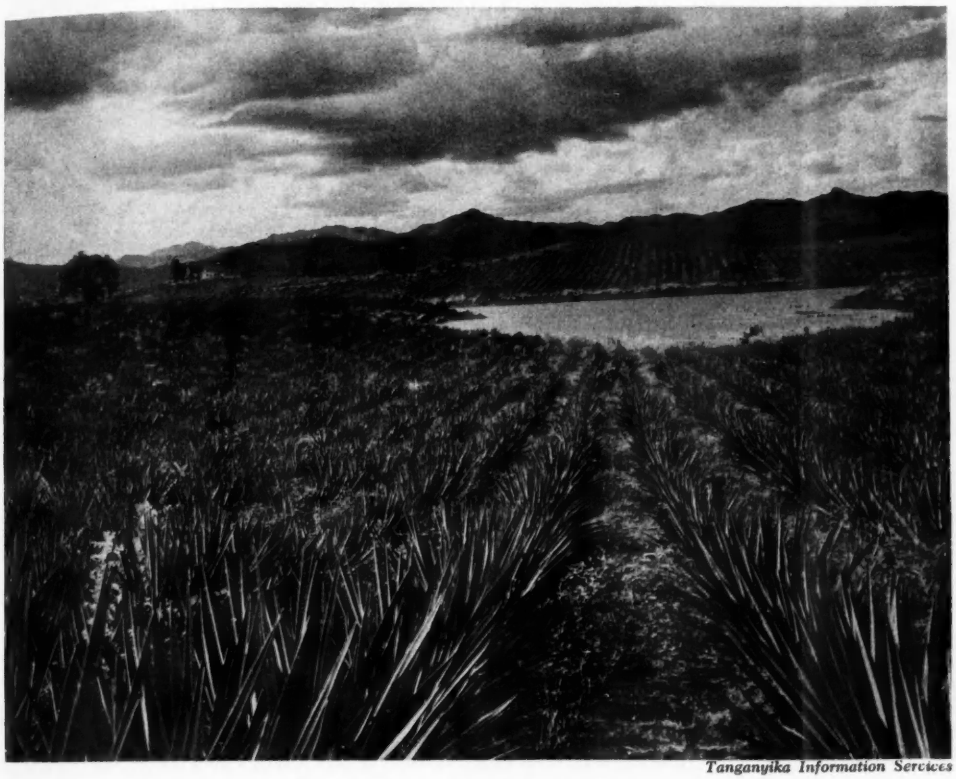
The lack of good all-weather roads in the coastal belt results in a rather active territorial coasting trade focussed upon Dar es Salaam. Much of this traffic is local, such as wheat from northern Tanganyika, or copra, but sisal and mangrove bark are collected at coastal points for transshipment overseas at Dar es Salaam. Petroleum products move from that port to smaller coastal points.

Air connections at Dar es Salaam are operated primarily for passenger movements. East African Airways have frequent services and Sabena has a weekly flight linking the port with Belgian Africa.

NATIONAL HINTERLAND

Through the system of feeders described above, Dar es Salaam can serve about 260,000 square miles of national territory and about five-sevenths of the total population (Fig. 8). Dar es Salaam is not without competition in its own tributary area, however, for Lake Victoria services permit Mombasa to penetrate the Lake Province hinterland, and improved services on Lake Nyasa may draw some Tanganyikan traffic to Mozambique ports.

[12] See H. Soudan, "La Navigation au Lac Tanganyika," *Journées d'Etudes des Transports au Congo Belge*, 5–6 Oct. 1956 (Brussels, 1957), pp. 343–405.



Tanganyika Information Services

FIG. 9. Sisal estate on the ascent to the Central Plateau, near Kilosa.

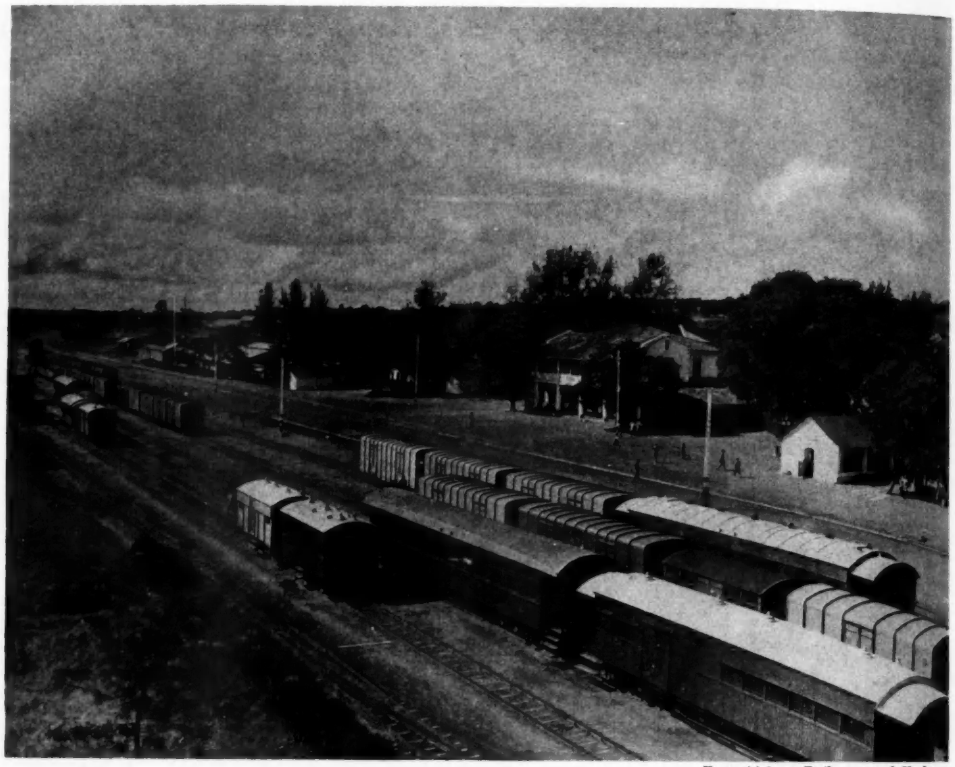
Eastern Province

The Eastern Province ranks first in traffic handled at Dar es Salaam, being closer to the port and better developed than interior areas. The coastal lowland from Bagamoyo to Utete is fairly well populated and receives sufficient rain to permit growth of many valuable tropical crops. The province rates second in production of African-grown cotton (c. 10,000 bales) and rice, and contains the largest number of Africans in paid employment, which increases its importance as a consuming area.

Over 30 percent of the country's sisal plantations are situated in the Eastern Province, their distribution being closely dependent on transport facilities. Many estates lie along the railway between the port and Kilosa (Fig. 9); others are within trucking distance of the wharves, while some are served by coastal vessels. The local road system has been improved by paving the Great West Road to Morogoro, while another highway is being constructed toward Iringa to link with the Great North Road, and several feeder roads are soon to be reconstructed.

The Rufiji River basin and especially the Kilombero Valley are considered to have great traffic potential, if a 130-mile rail extension to Ifakara is built, at an estimated cost of $11.2 million.[13] Shortage of capital, however, forced E. A. R. & H. to suspend laying this line in 1957. Inadequate funds also prevent linking the central and northern rail systems to replace the Morogoro–Korogwe road service.

[13] Major crops of rice, cotton, and sugar could be produced there according to detailed surveys still in progress by the Tanganyika Agricultural Corporation with the assistance of F. A. O. A South African sugar firm has already bid for a large concession and refinery with 50,000–100,000-ton capacity at Kiberege (Msolwa). See also U. K. Colonial Office, *East African Rice Mission Report*, Col. No. 246 (London: H. M. S. O., 1949), 78 pp.



East African Railways and Harbours

FIG. 10. Tabora rail junction on the Central Railway, an old trading and agricultural center in the Western Province.

Central and Western Provinces

The Central and Western Provinces are sparsely populated and low productive areas. Rainfall is low and extremely erratic,[14] inhibiting tillage agriculture. A few favored pockets around Tabora, Kahama, Nzega, Manyoni and Singida (formerly noted for its gold mines) do produce groundnuts and cotton for export. Beeswax is collected in western parts, and some timber is cut.

The primary regional activity of the Central Province is grazing, but commercialization is hindered by the uncertain climate, low nutritional content of the grasses, prevalence of the tsetse fly, and the customary reluctance of the African to part with his cattle. Tabora (Fig. 10), a trading center dating from Arab times, is the chief cattle market of Tanganyika Packers, Ltd. Supply is often deficient, but in 1956 some 115,000 head were transported on the livestock express trains to Dar es Salaam.

Output of the Uruwira Minerals, Ltd., lead mine at Mpanda has not yet reached high levels, total traffic on the branch line being only about 25,000 long tons yearly, but shipments of lead concentrates could become an important addition to the Central Railway's traffic. Construction of the Mpanda branch also improved access to the neglected yet promising Ufipa Highlands in the extreme southwest.

Lake Province

With the exception of some lacustrine lands, Lake Province also suffers from low and uncertain precipitation. The Bukoba area west

[14] See Maps 2 and 3, "East Africa. Population, Tsetse Fly and the Prospect of 20 Inches of Rain," and ". . . 30 Inches of Rain," *East Africa Royal Commission 1953–1955 Report* (London: H. M. S. O., 1955).

of the lake, one of the more favored regions, ships all its coffee via Kenya. Cotton production, however, is increasingly important in the "cultivation steppe" of Ussukuma, which extends up to 40 miles inland from Lake Victoria. The acreage under cotton between Geita and Musoma doubled in the last few years, production reaching 27,600 long tons of fiber in 1956. About a third is auctioned at Kampala and shipped overseas via Mombasa, and the remainder moves via Dar es Salaam. Continued growth in output, estimated at 50 percent for the next decade, will require improvements in the local road net.

The Lake Province also produces rice (milled at Mwanza), peanuts, cattle, and maize. Musoma's backcountry produces ghee (clarified butter). Again, a large share of these commodities is routed to Kenya.

Haulage of equipment and supplies for the gold mines near Geita and Musoma and for the fabulous Williamson diamond mine at Mwadui is an appreciable source of revenue for the Tabora–Mwanza branch and the main line of the Central Railway. A 9-mile subbranch from near Shinyanga facilitates shipments to the Williamson workings. The Geita Gold Mining Co., largest producer of gold in the territory, receives its goods by road and the port of Nungwe.

Southern Highlands Province

The major factors inhibiting production in the Southern Highlands Province are its remoteness and the high cost of transportation to exterior markets. A branch line from the Central Railway was considered in the early years of the century and, fortified by this prospect, white settlement started there in 1904–05. Although not comparable to the Kenya Highlands, several elevated zones southwest of Iringa are considered favorable for permanent European settlement.

The most recent survey for a possible railway to the Southern Highlands was made in 1948–49 as part of an East African and Central African rail connection, shelved because of the high investment required (estimated in 1952 at $92.4 million for the 1,200-mile link.)[15] E. A. R. & H. serve the European farmers still resident in this area by their longest, low-rate motor schedule. The two main road services to the Dodoma and Itigi railheads lift some 36,000 long tons yearly, while shorter hauls are run on the roads lateral to the Great North Road. The ton-mile cost on these services is about double that of rail haulage, and only high-value, low-bulk commodities can stand the burden of transport charges. Exports from non-African estates include coffee (c. 600 long tons) from Mbozi, tea (c. 2,000 long tons) from Mufindi and Tukuyu, pyrethrum from Mufindi and Njombe, and flue-cured tobacco (c. 2,000 long tons) from around Iringa, where it is grown by Indians and Greeks. Tobacco moves only 162 miles by road to the Dodoma railhead, but coffee may face a journey of 500 miles. Some fruit, vegetables, and flowers are shipped by air to Tanganyikan markets.

The African population in the area is generally sparse, partly as a consequence of German suppression of the "Maji Maji" rebellion in 1905. Densities are very high in the Rungwe Mountains, however, which have been an important source of migrant labor. The government has recently promoted the planting of wattle by Africans at Njombe, and hopes for an eventual yearly output of 12,000 long tons of tanning extract, which would be exported via Dar es Salaam.

Exploitation of known mineral resources has also been disadvantaged by the absence of railways. The Lupa gold fields are reported to be close to exhaustion, but the coal reserves in the Kiwira–Songwe area and those just across the provincial border in the Southern Province (the Ruhuhu coal fields near the Liganga iron deposit) are very extensive. Despite poor transport prospects, Dutch interests have recently secured a concession on a pyrochlore deposit south of Mbeya and plan to produce 5,400 long tons of concentrates in 1958–59.

Thus far the Southern Highlands have not left the orbit of Dar es Salaam. But if a connecting railroad is not built to the area within the next decade, in all likelihood the proposed navigational improvements on Lake Nyasa, upgrading of the Mbeya–Mwaya road, and extension of the northern Mozambique line from Nacala to the Lake Nyasa shore, sched-

[15] See Colonial Office, *A Development Survey for the Central African Rail Link* (London: Alex. Gibb and Partners; New York: Overseas Consultants, Inc., 1952), 2v.; E. A. R. & H., *A Report on the Engineering Survey of a Rail Link between the East African and Rhodesian Railway Systems* (Nairobi, 1952).

uled for 1959,[16] would draw a part of the province's trade toward either Beira or Nacala in Mozambique, the normal outlets of the Nyasa region.

EXTRA-NATIONAL HINTERLANDS

Belgian Congo and Ruanda-Urundi

When Ruanda-Urundi was a part of German East Africa, a rail route to this interior area was planned from Tabora. The Belgians, to whom the territory was mandated in 1923, attempted to funnel its trade via Matadi, the national port of the Congo. The Ten-Year Plan (1950–60) for Ruanda-Urundi did recognize that it belongs geographically to the hinterland of Indian Ocean ports,[17] but no concrete steps have been taken toward rerouting traffic eastward.

Economic progress in Ruanda-Urundi is severely handicapped by its remote location, by its rugged and in places severely eroded lands, and by overpopulation (4.4 million in 1956 on 20,910 sq. mi.). Agriculture is perforce concerned primarily with meeting internal demand; output of minerals is limited to a few thousand tons a year of cassiterite, mixed tin and rare metal ores, and gold. In 1956 total exports were 105,444 metric tons, valued at $38.6 million. Imports in the same year were 182,878 metric tons valued at $45.6 million. However, 77 percent of exports and 66 percent of imports were interchanges with the neighboring Belgian Congo.[18]

Three-fourths of the main export of Ruanda-Urundi, coffee (c. 22,000 metric tons yearly), and nine-tenths of total external shipments pass through the port of Usumbura on Lake Tanganyika, the capital and premier commercial center of the country. *Arabica* coffee comes 60 to 125 miles from Astrida, Nyanza, Ngozi, Muhinga, and Kitega districts; *robusta* moves about 40 miles from the zone between Usumbura and Bubanza. Most of the castor seed, cotton, tobacco, pyrethrum, and hides follow the same motor routes, there being no railways in Ruanda-Urundi. Rumonge and Nyanza-Lac, south of Usumbura, are minor shipping points.

In 1955 only about 29,000 metric tons were exchanged between Usumbura and Kigoma, head of the Central Tanganyika Railway, while close to 50,000 metric tons of Ruanda-Urundi's overseas traffic moved via Congo routes from Albertville to Matadi. Of these, the Congo–Lualaba route totals 2,175 miles from Usumbura and the Bukama–Port Francqui route totals 2,235 miles, as compared to 807 miles on the route to Dar es Salaam, which also has fewer transshipments. A trickle of overseas trade also leaves via Kakitumba to Mombasa. Exchanges with the Congo usually move via Usumbura, Shangugu, or Kisenyi.

The port of Usumbura, whose traffic totalled 268,739 metric tons in 1956, has had two small jetties providing only inadequate protection to vessels at anchor, 2,880 square meters of sheds, 26,000 square meters of stacking grounds, and a light, narrow-gauge track within the harbor area. A recent loan from the World Bank will be applied in part to reconstructing the port around an interior basin with a breakwater to raise its capacity to 350,000–400,000 metric tons. Operations at Usumbura have also been handicapped by an imbalance of 4 to 1 in import and export tonnages. Even larger import through Usumbura should result from the proposed modern highway to Bukavu, the trade of this locality now moving mainly through Kalundu (Uvira) on the Congo side of Lake Tanganyika. Kalundu handled about 77,000 metric tons in 1955.

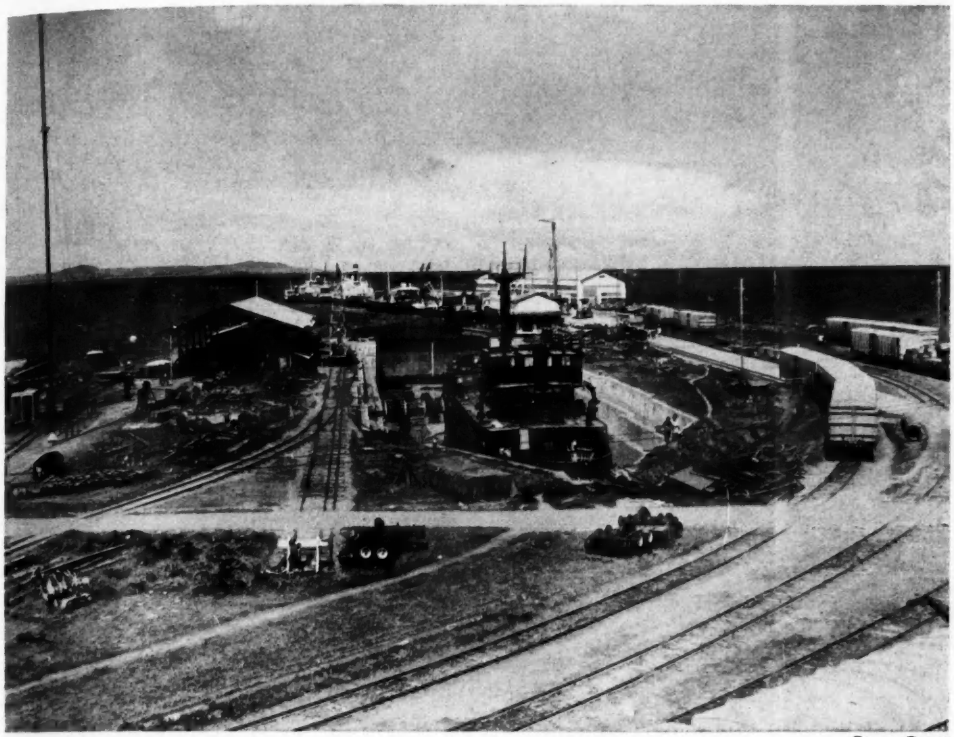
It is extremely difficult to define with any precision the area in the eastern Congo that might be considered tributary to Dar es Salaam. The Germans hoped that the Central Railway would attract mineral traffic from the Katanga, but completion in the early thirties of the B. C. K. (Chemin de Fer du Bas-Congo au Katanga) gave the Belgians a much more convenient national route, while the railways to Lobito and Beira, providing uninterrupted connections with the seaboard, secured the remaining mineral shipments.

At present, about 60 percent of Dar es Salaam's transit trade is with the European-settled region on the southern and western shores of Lake Kivu, centered on Bukavu, and with the Albertville (Fig. 11) region on Lake Tan-

[16] See I. S. van Dongen, "Nacala, Newest Mozambique Gateway to Interior Africa," *Tijdschrift voor Economische en Sociale Geografie*, 48th year (March 1957), pp. 65–73.

[17] Belgium, Ministère des Colonies, *Plan Décennal pour le Développement Économique et Social du Ruanda-Urundi* (Brussels: De Visscher, 1951), p. 206.

[18] Belgium, *Rapport Soumis par le Gouvernement Belge à l'Assemblée Générale des Nations-Unies au Sujet de l'Administration du Ruanda-Urundi pendant l'Année 1956* (Brussels, 1957), p. 397.



Congo Presse

FIG. 11. The Congo port of Albertville on the shores of Lake Tanganyika, base of the Belgian lake fleet and a communication node in the extra-national hinterland of Dar es Salaam.

ganyika. Both areas are logically dependent on the central Tanganyika route, but much of their trade continues to move via Matadi in accordance with Belgian transport policy. During 1950–55, Dar es Salaam was particularly important as their supplier of petroleum products, and the Congo Ten-Year Plan recommended construction of storage at Kigoma to improve delivery on that route. However, the Belgians apparently now intend to route even this traffic via Matadi through the new petroleum tankage at Port Francqui, the recently completed Kamina–Kabalo rail link for the supply to Albertville, and then by lake tank-barges to Usumbura.

Federation of Rhodesias and Nyasaland

Tanganyikan connections with Northern Rhodesia are by the Great North Road and the E. A. R. & H. services on Lake Tanganyika. No overseas trade moves between these territories over the Great North Road, but Mpulungu (Fig. 12) has shipments moving through Dar es Salaam, particularly fuels and cement destined to the European farming area around Abercorn.

The projected East Africa–Central Africa rail link may have appeared very appealing in the late forties when the Rhodesia Railways and Beira were severely congested. The route from Dar es Salaam to Ndola, center of the copperbelt of Northern Rhodesia, would have been shorter than those from other central African outlets (1,340 miles as compared with 1,400 from Lobito and 1,450 from Beira). But alleviation of the pressure, by completion of the Limpopo link to Lourenço Marques[19] in 1955, and by new agreements liberalizing movement on the route to Lobito starting in

[19] See W. A. Hance and I. S. van Dongen, "Lourenço Marques in Delagoa Bay," *Economic Geography*, July 1957, pp. 238–56.

British Information Services

FIG. 12. Mpulungu, the point of entry into Northern Rhodesia, at the southern end of Lake Tanganyika. An E. A. R. & H. steamer serving this route is at the quay.

January 1957, has eliminated any immediate need for the Federation to seek an East African outlet.

Kenya and Uganda

Prior to World War II, Mombasa played a rather important role as an entrepôt for Dar es Salaam. Since the improvement of facilities at the latter port, no part of Kenya or Uganda has yet come within its hinterland, though the central Tanganyika route is a potential alternate to Mombasa, at least for Uganda. It is possible that the establishment of tobacco and cotton factories at Dar es Salaam may be sufficiently attractive to draw raw materials from the Protectorate. But the Kenya and Uganda outlet has also raised its handling capacity by construction of new quays at Kilindini, and it has the advantage of a shorter rail haul, not only for Uganda but for portions of Tanganyika as well.

SUMMARY AND CONCLUSION

The tributary area of Dar es Salaam embraces an extensive region both within the Trust Territory and in adjacent extra-national areas. At present, extra-territorial traffic represents under 10 percent of the port's trade, though it accounts for about 20 percent of freight revenue on the Central Tanganyika Railway. A substantial increase in transit traffic will require not only continued economic buildup in Belgian Africa, but also relaxation of the "Voie Nationale" policy. No spectacular increase can be expected in transit trade with adjacent British territories.

Traffic demands of the national hinterland have only recently begun to expand with force, but the large areas of low productive capacity restrict the potential flow. Nevertheless, there is considerable scope for expanded economic activity not only in areas already well served by the port's feeders but in areas

such as the Kilombero and Rufiji valleys and the Southern Highlands, where transport improvements would stimulate greater domestic traffic offering. And there is always the possibility that intensified prospecting may lead to large-scale mining activity, requiring and justifying new rail lines.

A major limitation to the rate of advance that may be expected is the lack of adequate investment capital. E. A. R. & H. has encountered great difficulties in securing long-term loans for the construction of desirable rail lines, and only a minor part of needed extensions can be financed from current revenues despite increases in port and rail rates. Recent failure in floating a loan on the London market has even required cutbacks in improving and augmenting present trackage and equipment, which may presage another period of transport difficulties for all East Africa. Heavy capital investment is also required for the development of land productivity that will continue to build up the traffic of the Central Railway and Dar es Salaam.

GENERAL CARGO HINTERLANDS OF NEW YORK, PHILADELPHIA, BALTIMORE, AND NEW ORLEANS[1]

DONALD J. PATTON
University of Maryland

REFERENCES to port hinterlands occur frequently in geographical literature, but progress in the development of concepts relative to the circulation of traffic to and from ports, and to the nodality of ports themselves, has been impeded by appreciable gaps in our quantitative traffic flow data, more so with port hinterlands than with the direct overseas connections of ports. Although increasingly quantitative work did begin to appear for European port hinterlands well before the Second World War, attempts at quantitative delineation of North American port hinterlands have been few.[2] In the main, delineation of American port hinterlands has received such scant attention that aspects of port study relating to port hinterlands have either been slighted or given overgeneralized treatment. Analysis of a host of problems which challenge attention in the spatial relations of North American ports should profit from increased quantification of port hinterland relations.

The present contribution to the study of port hinterlands has three objectives. First, hinterland origin and destination maps are presented for port traffic of a general cargo nature for New York, Philadelphia, Baltimore, and New Orleans, the four leading cargo ports in the eastern half of the United States. The intent has been to focus on a restricted—although important—phase of total port traffic for several ports simultaneously, rather than on all phases of a single port's traffic. The view has been broadened horizontally, as it were, to encompass in juxtaposition the continental movements of general cargo to and from the four leading ports. This should permit at least a glimpse of the relative ability of each of the several leading ports to command the import and export traffic of the continent. Second, several general conclusions are presented regarding the relative importance of factors contributing to the hinterland patterns depicted. Third, several problems are suggested which would appear to merit attention in further research relating to the spatial relations of ports.

MAPS OF THE GENERAL CARGO HINTERLANDS

The accompanying maps are restricted to general cargo traffic moving to and from port areas by rail in carload lots. General cargo is in many respects the cream of port traffic, yielding much higher revenues to port areas per ton handled than bulk cargoes. In spite of the inroads which trucking is making into the hauling of general cargo to and from ports, railroad carload movements remain the basis whereby the greater proportion of the total general cargo traffic moves to and from American ports, except at New York, where rail-borne carload traffic accounts for about half of the port's volume of general cargo business. The traffic origins and destinations are mapped exclusively for general cargo moving in foreign trade, but, again with the exception of New York, coastwise and intercoastal general cargo handling is slight compared to foreign traffic. Even at New York, such traffic is under 10 percent of the total general cargo port traffic.

The hinterland maps are the results of the compilation of all railroad traffic of a general cargo nature serving each particular port for the month of June, 1955.[3] Individual com-

[1] Preparation of this paper has been supported by the Office of Naval Research. It is one of a series of studies relating to the Atlantic and Gulf port hinterlands of North America. The writer wishes also to acknowledge the painstaking work of Ronald Miller, who aided in gathering of the original statistical data and who compiled the data for map presentation. The maps were prepared by Alfred Gwynn.

[2] Edward L. Ullman, *Mobile: Industrial Seaport and Trade Center* (Chicago, 1943).

[3] With the exceptions noted below. Data for maps and tables were derived from the following railroads: New York Central; Pennsylvania; New York, New Haven, and Hartford; Delaware, Lackawanna and Western; Lehigh Valley; Central Railroad of New Jersey; Erie; Reading; Canton; Baltimore and Ohio; Western Maryland; Gulf, Mobile and Ohio; Louisville and Nashville; Illinois Central; Southern; Kansas City Southern; Texas and Pacific; Missouri Pacific; and Southern Pacific. The Pennsylvania Railroad supplied data for the New York, Philadelphia, and Baltimore port areas, and the Baltimore and Ohio for the Baltimore and Philadelphia port areas. Tables 1 and 2 were compiled from statistical data of foreign traffic freight car movements secured through analysis of

modity movements, originally derived separately from railroad company files, were added together to compute the totals for each point of hinterland origin or destination on the separate import and export maps for each of the four ports selected. Only traffic moving directly through each of the four ports has been considered here, including traffic originating or terminating in the port city itself.

Before the maps were drafted in final form, a considerable period of experimentation was undertaken to ascertain a suitable sample period for the compilation of data. A number of individual commodities were studied at several ports for varying lengths of time from a day to a year or more. Possible seasonal variations were also studied. In summary, it was decided that one month gave an accurate enough picture of a port's hinterland spatial relations for general cargo, and that seasonal variations of *general cargo* movements are minor at the ports in question. To make the results more strictly comparable, the month of June, 1955, was used at each of the ports.[4]

EXPORT TRAFFIC

The inland origins of railroad carload traffic of a general cargo nature, waybilled to Philadelphia, New York, Baltimore, or New Orleans for export are shown for each of the four ports separately in Figures 1, 2, 3, and 4, respectively. Comparison of the four maps reveals the disparity of area in which each of the four ports predominates in the routing of export traffic. These relationship are quantitized on a state by state basis in Table 1.

The map of Philadelphia's export hinterland for general cargo shows that Philadelphia derives most of its general cargo export traffic from a small area, hardly larger than the state of Pennsylvania. Little export traffic is drawn from any area west of Youngstown, Ohio. Comparison of the Philadelphia export map with maps for Baltimore and New York indicates further that Philadelphia dominates export trade in an extremely small area, confined to the Delaware Valley from Trenton to Wilmington. In the immediate inland environs of Philadelphia, in the area centering on the cities of Lancaster and Reading, Pennsylvania, New York commands a greater export traffic than Philadelphia. Philadelphia is moderately surpassed by New York in the Harrisburg area, and falls far behind New York in the Bethlehem–Allentown complex. Finally, although Philadelphia handles an appreciable volume of export traffic originating in the manufacturing centers of western Pennsylvania, New York attracts about four times as much carload general cargo export traffic from the same area. West of Youngstown, Philadelphia's competition vis-à-vis New York disappears almost entirely.

New York is able to draw a greater number of carload consignments than Philadelphia from all parts of Pennsylvania northwest of the Delaware estuary in spite of the rate advantage which Philadelphia has on export traffic originating in all parts of the state except the northeast quadrant. Throughout the Middle West, where Philadelphia's standard port differential below that of New York on export consignments has been traditionally two cents per hundred pounds, the rate advantage favoring Philadelphia would appear to be inconsequential in the face of contravening advantages of shipment via New York, including the superior cargo liner sailings and commercial services of that port. It may be noted that in the anthracite region of Pennsylvania, the one section of the state where New York does possess a rate advantage over Philadelphia, there is a general lack of production for export and the area has scant importance for Philadelphia's export trade and little importance even for New York.

Baltimore likewise contends with Philadelphia for the export traffic from central and western Pennsylvania. Baltimore has a virtual three-way split with Philadelphia and New York for export traffic originating at points in

freight bills filed in the district freight offices of railroads serving the port areas of New York, Philadelphia, Baltimore, and New Orleans, and from statistical data secured through analysis of unpublished data filed in the foreign freight traffic offices of the several railroads.

[4] Since export general cargo may not clear the port during the same calendar month that it enters the port area by rail, the thirty-day interval has here been calculated on the basis of freight car arrivals of goods with foreign consignments. The import maps have likewise been compiled on the basis of the date of carload dispatch of freight which has been imported through the port in question. The maps include export traffic which was being consigned to warehouses for an interval of time before export, and import traffic released from warehouses during the thirty-day interval. The greater part of the traffic shown on the maps actually entered or cleared the ports, however, during the month of June, 1955.

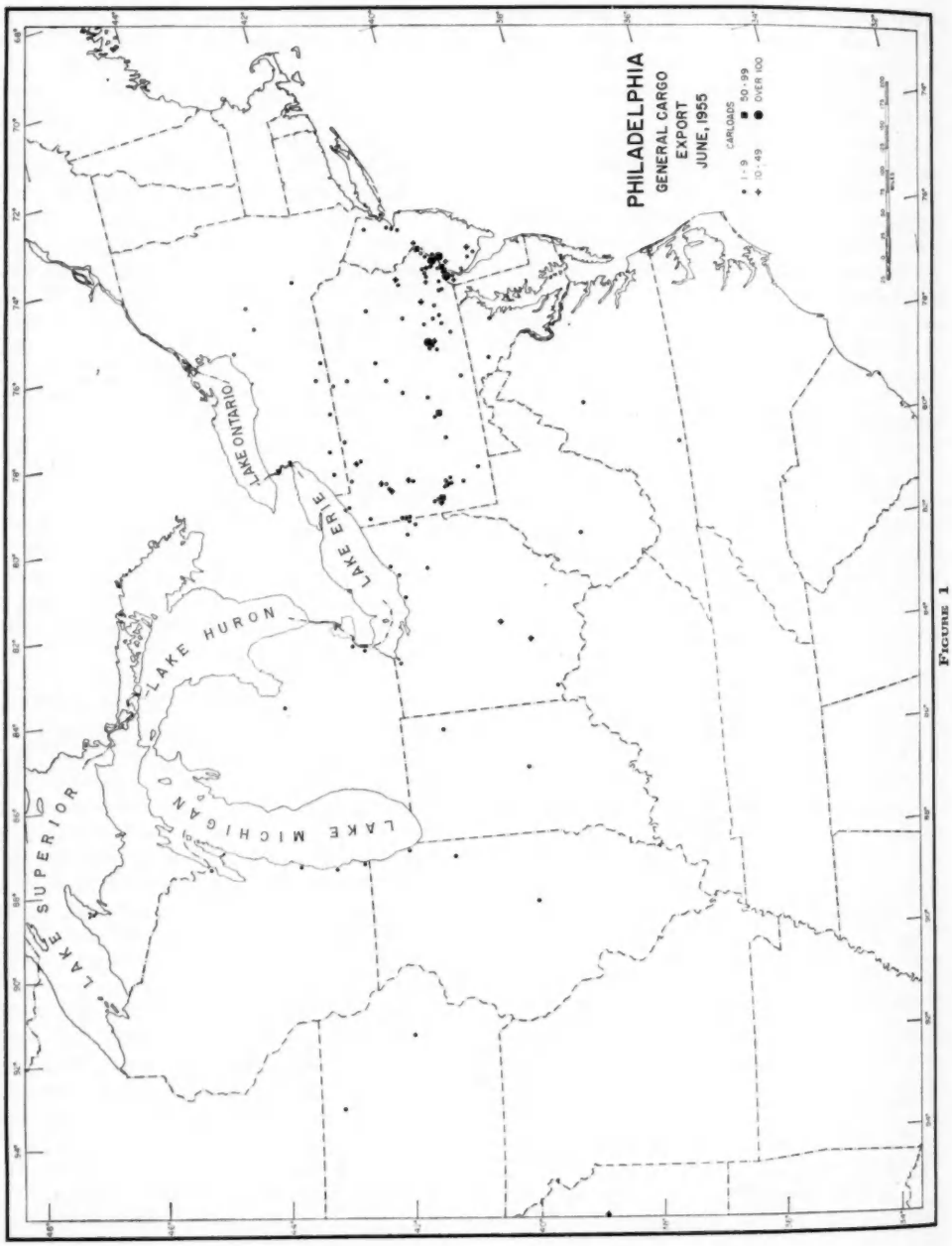

PHILADELPHIA
GENERAL CARGO
EXPORT
JUNE, 1955
CARLOADS
1 - 9
10 - 49
50 - 99
OVER 100
LAKE ONTARIO
LAKE ERIE
LAKE HURON
LAKE MICHIGAN
LAKE SUPERIOR

FIGURE 1

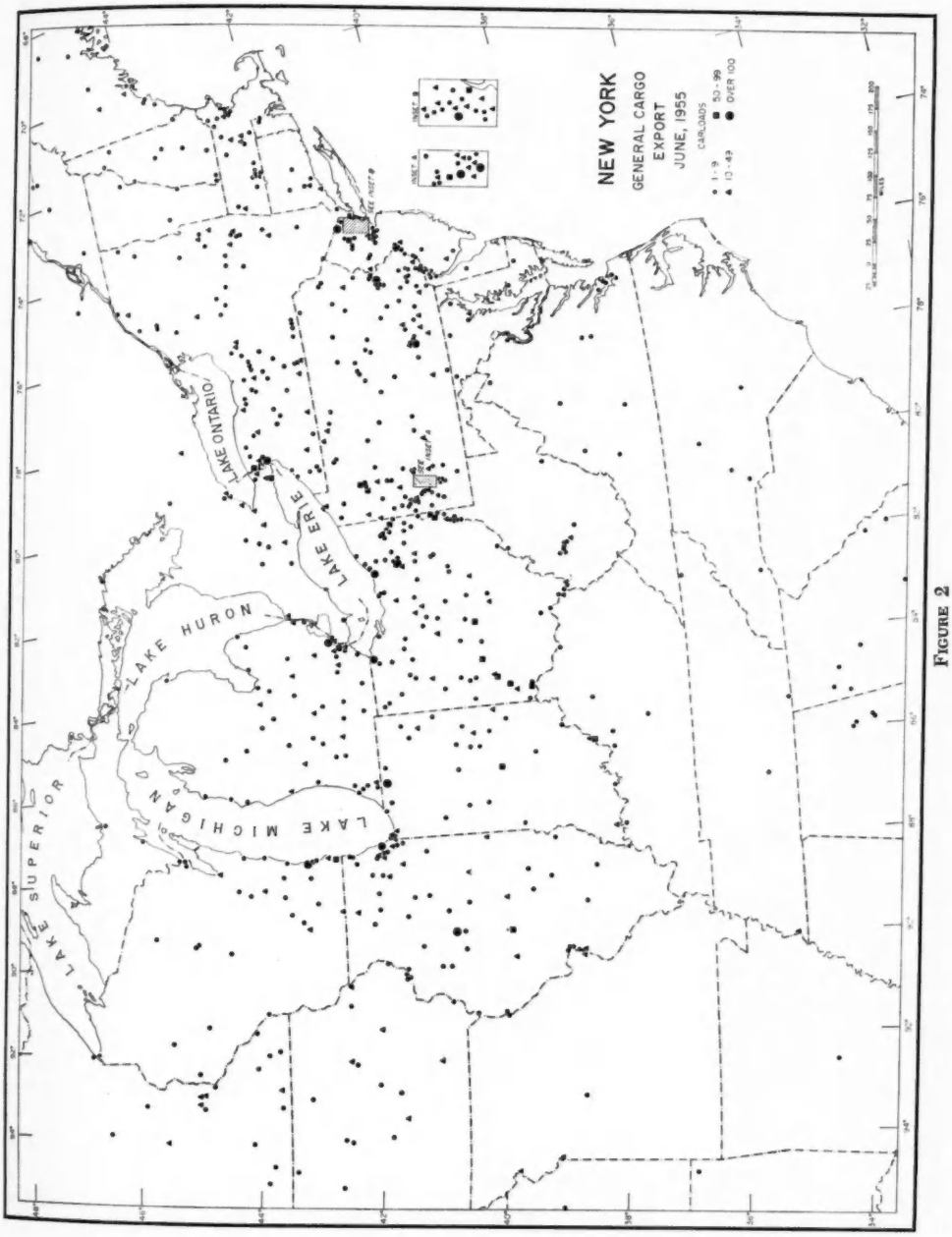

NEW YORK
GENERAL CARGO
EXPORT
JUNE, 1955
CARLOADS
1 - 9
10 - 49
50 - 99
OVER 100
INSET A
INSET B
LAKE ONTARIO
LAKE ERIE
LAKE HURON
LAKE MICHIGAN
LAKE SUPERIOR

FIGURE 2

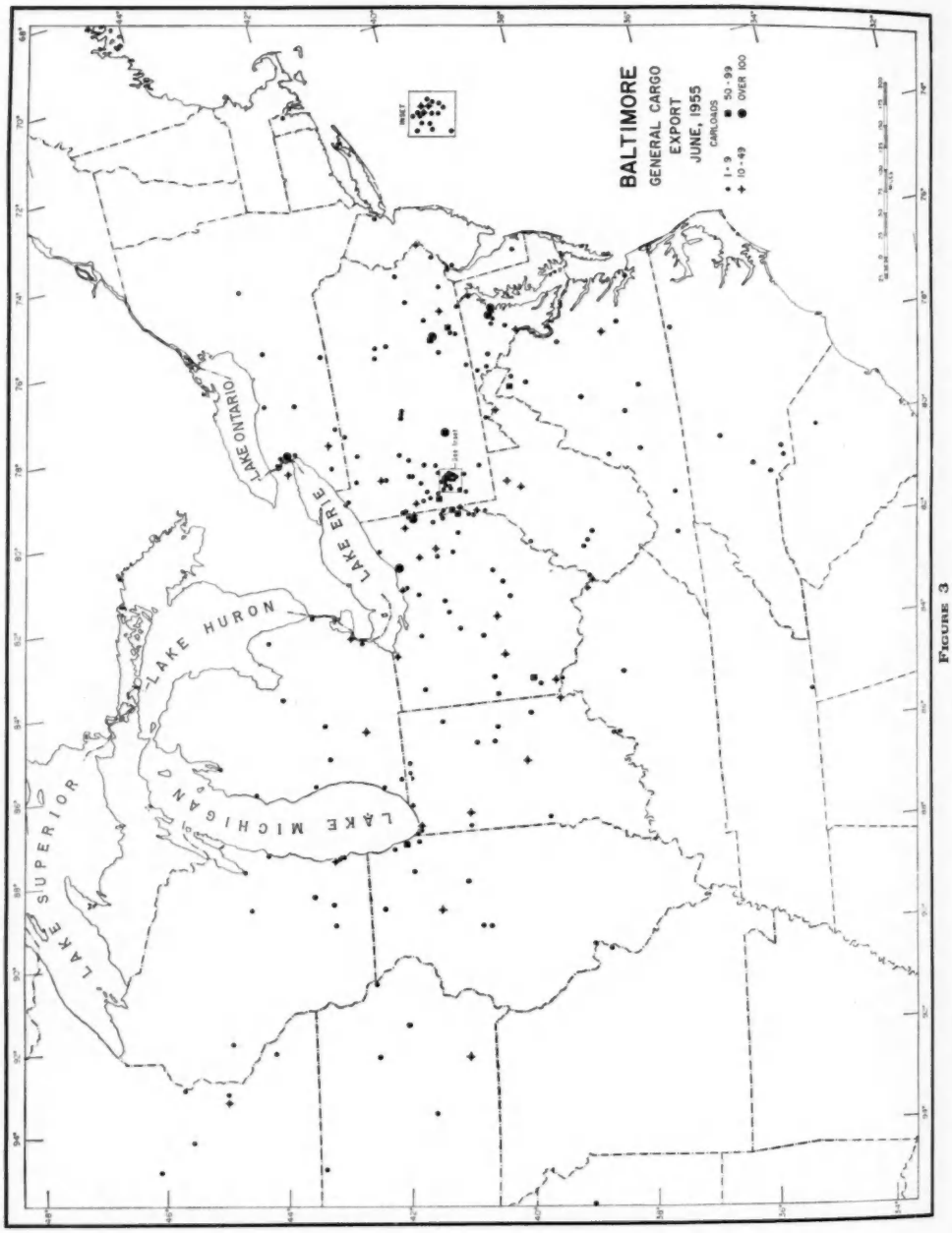

BALTIMORE
GENERAL CARGO
EXPORT
JUNE, 1955
CARLOADS
1 - 9
10 - 49
50 - 99
OVER 100
INSET
LAKE ONTARIO
LAKE ERIE
LAKE HURON
LAKE MICHIGAN
LAKE SUPERIOR

FIGURE 3

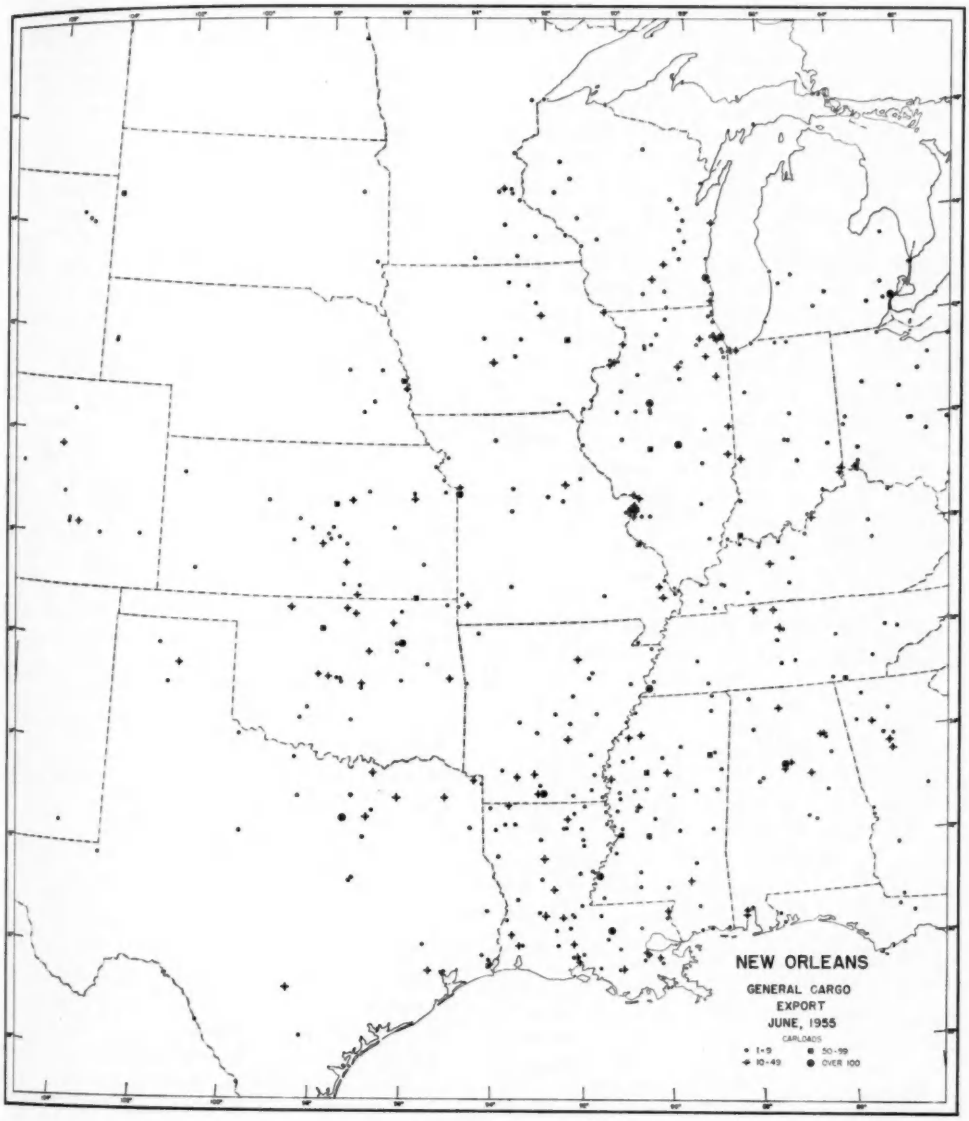

NEW ORLEANS
GENERAL CARGO
EXPORT
JUNE, 1955
CARLOADS
1-9
10-49
50-99
OVER 100

FIGURE 4

TABLE 1.—TOTAL GENERAL CARGO EXPORTS, BY STATES, THROUGH THE PORTS OF NEW YORK, PHILADELPHIA, BALTIMORE, AND NEW ORLEANS, JUNE, 1955[1]
(Quantities in carloads)

Exporting State	New York	Philadelphia	Baltimore	New Orleans
New England				
Maine	51	—	—	—
New Hampshire	17	—	—	—
Vermont	8	—	—	—
Massachusetts	162	—	—	1
Rhode Island	2	—	1	—
Connecticut	37	—	—	1
Middle Atlantic				
New York	1330	31	150	4
New Jersey	357	216	5	3
Pennsylvania	1878	1929	721	9
East North Central				
Ohio	1221	38	771	47
Indiana	252	12	122	169
Illinois	726	13	86	1111
Michigan	994	10	113	127
Wisconsin	227	9	49	243
South Atlantic				
Delaware	5	191	2	—
Maryland	65	4	479	1
District of Columbia	—	—	44	—
Virginia	37	8	99	7
West Virginia	161	4	189	8
North Carolina	17	—	13	13
South Carolina	—	—	1	—
Georgia	10	—	2	103
Florida	—	1	—	33
East South Central				
Kentucky	36	—	38	119
Tennessee	24	—	1	356
Alabama	11	—	—	377
Mississippi	—	—	2	585
West North Central				
Minnesota	153	—	44	52
Iowa	215	4	22	168
Missouri	78	10	2	465
North Dakota	—	—	—	1
South Dakota	22	—	6	58
Nebraska	21	—	—	101
Kansas	12	11	3	291
West South Central				
Arkansas	1	—	—	341
Louisiana	3	—	—	1215
Oklahoma	3	—	—	409
Texas	36	—	—	388
Mountain				
Montana	—	—	—	3
Wyoming	—	—	—	14
Colorado	17	—	—	100
New Mexico	—	—	—	4
Idaho	2	—	—	9
Utah	35	—	—	10
Arizona	2	—	—	41
Nevada	1	—	—	—
Pacific				
Washington	6	—	—	28
Oregon	5	—	—	2
California	174	—	—	102
Canada				
Nova Scotia	1	—	—	—
New Brunswick	4	—	—	—
Quebec	37	—	—	—
Ontario	394	—	29	—
Manitoba	11	—	—	—
Saskatchewan	20	—	—	—
Alberta	1	—	1	1
British Columbia	2	—	—	—
Mexico	—	—	—	—
Total	8884	2491	2994	7119

[1] Table subject to same statistical limitations as noted for the maps. See text footnote 3 for source.

the southern Susquehanna Valley, while in the Pittsburgh – Wheeling – Youngstown triangle farther west Philadelphia is quite eclipsed by Baltimore as well as by New York. The heavy export flows from the Buffalo area and western Pennsylvania to Baltimore attest that port's ability to cut in northwestward behind Philadelphia for a very sizeable share of its total export traffic. Bulking large in these export movements are shipments of sheet steel, tin plate, steel bars and rods, terneplate and piping, together with heavy machinery and transport equipment, all moving toward the port which also handles a large share of the Sparrow's Point steel export over its general cargo piers. The orientation of iron and steel consignments toward Baltimore rather than Philadelphia is exemplified by Johnstown, Pennsylvania, which during the sample period dispatched over 100 export carloads to Baltimore, and less than ten export carloads to Philadelphia. The tendency for steel exports to concentrate at Baltimore is further shown by the heavy steel traffic from Buffalo to Baltimore, whereas the entire Niagara frontier is of scant importance for Philadelphia's export trade.

Most of the general cargo exports dispatched toward the Atlantic Seaboard from the group of Middle Western states north of the Ohio and east of the Mississippi rivers are handled either by Baltimore or New York. While New York clearly surpasses Baltimore throughout the Middle West, the traffic which Baltimore does attract attests to the effect which its port differential seems to have. Export rates from Midwest origins via

Baltimore have traditionally averaged three cents per hundred pounds below export rates via New York, and one cent below export rates via Philadelphia. It would appear that insofar as Middle Western export shipping may be influenced by export rates, Baltimore is chosen in preference to Philadelphia.

Baltimore draws little export traffic from the South. The Hampton Roads group of ports "pirate" a considerable amount of traffic which would otherwise seek a seaboard exit at Baltimore, and four other Southern ports, Charleston, Savannah, Mobile, and New Orleans, draw from a common territory south of the Ohio and south of the Virginia–North Carolina state line.

Several other noteworthy features are revealed by the maps of carload rail traffic moving to Baltimore and Philadelphia for export. Large volumes of short haul rail traffic move toward both Philadelphia and Baltimore. Philadelphia is particularly outstanding in this respect, since almost half of the total export traffic of the port is derived from the Delaware group of origin points, all within forty miles of Philadelphia piers. Clearly rail transport is more important than sometimes assumed for short haul movements to shipside. The greater part of these short hauls originate at railroad sidings of industrial plants booking sufficient space on outbound vessels to justify carload lot shipments to shipside. Examples of traffic moving in volume on short hauls include tractors (from York, Pennsylvania, to Baltimore), semi-fabricated steel products, heavy machinery, containers, paint, and boxed chemicals.

The general cargo hinterlands of New York actually extend throughout the United States and over much of southern Canada.[5] The port is able to compete for export traffic in almost every area where Philadelphia and Baltimore are active, as well as over vast areas where the pulling power of these two other ports is weak. Even in one of the most important segments of the Baltimore export general cargo hinterland, the Pittsburgh–Youngstown area, Baltimore handles only about 25 percent of that area's exchange with overseas areas, primarily due to the competitive role of New York. New York has an almost clear field in the group of cities between Albany and Buffalo as well as in the urban concentrations of southern New York state and northeastern Pennsylvania. New York draws the bulk of New England's export traffic, as has been pointed out frequently, attracting considerable traffic even from the Boston metropolitan area itself. The decrease in the intensity of New York's hinterland west of the Mississippi River is associated less with declining New York dominance in that area than with the generally wider spacing of points shipping freight of a general cargo nature destined for export. Not only does New York receive a greater number of carloads of export traffic from a large number of hinterland origins than any other United States port, but the variety and range of goods arriving in New York by rail is greater than that reaching any other port. This is particularly true of traffic arriving from points more distant than 600 to 700 miles, where motor transport is less competitive than closer to New York.

The port of New Orleans forwards general cargo export traffic from an array of origins scattered over a vast area of sub-continental dimensions.[6] The size of its export hinterland is a reflection both of its absolute importance as a general cargo port, surpassing all other North American ports on a general cargo basis except New York, and of its relative importance on the Gulf Coast, where it has no close rivals in the general cargo field. New Orleans attracts export shipments from points deployed as far northward as Lake Superior, northeastward to the environs of Lake Erie, and northwestward to the central and northern Great Plains, and to the Denver area.

The core of the New Orleans export hinterland remains the Mississippi Valley itself, from the vicinity of New Orleans northward to Wisconsin. The historic north–south traffic axis associated with the river is now continued

[5] Figures for 10.58 percent of the total New York export traffic, representing the traffic of one railroad serving the port, were not available for June, 1955, but figures for February, 1955, a period of comparable freight activity (98 percent of the June, 1955, activity for this railroad) were used. Modification of the export pattern from that which would be shown if June, 1955, figures had been available throughout is probably very slight.

[6] The three maps for New Orleans represent approximately 96.5 percent of the port's total carload traffic. The other 3.5 percent was not available, but would originate and terminate primarily in the eastern one-third of the hinterland area. Cotton consigned to foreign destinations after warehouse storage in the port area is also not included.

by rail lines parallel to the river's course, particularly by the main line of the Illinois Central railroad between Chicago and New Orleans. Within the core area of the New Orleans hinterland, two areas contribute especially heavily to the export volume: Illinois and the lower Mississippi Valley. Much of the traffic originating in Illinois falls into either one of two categories, consisting either of machinery and vehicles, including agricultural and earth-moving machinery bound for Latin American destinations, or products of agricultural processing plants, including flour, corn meal and corn products, feed concentrates, and milled soybean products. Many of the shipping points from Memphis southward represent high density cotton compress centers shipping cotton to New Orleans for ultimate overseas consignment.

Several other features may be noted on the New Orleans export map. The Birmingham and Gadsden districts of Alabama stand out by virtue of their exports of sheet steel, pipe, and tin plate. Detroit, over a thousand miles from New Orleans, uses the port extensively for automobile exports to Latin America. To the northwest of New Orleans the profuse scattering of shipping points extending from north central Kansas southward to northern Texas is a result not only of exports of milled agricultural products, but also the importance of this region, corresponding in general with the mid-continent petroleum province, for the manufacture and export of oil well drilling equipment and supplies. Southward from the Dallas–Fort Worth area New Orleans comes increasingly under the competitive influence of Houston and Galveston, and the margin of the export hinterland area retreats to the Sabine River. Finally, the dearth of shipping points in the Great Plains and in the rough areas of the Ozark and Ouachita Highlands stands out in relatively blank areas on the map.

The export hinterland of New Orleans extends far enough northward to overlap part of the export cargo hinterlands of both Baltimore and New York, particularly in northern Illinois, southern Wisconsin, extreme northwestern Indiana, and southern Michigan. In northern and central Illinois, New Orleans approximates New York in the amount of traffic which it attracts. The increasing influence of New Orleans southward may be seen by comparing the relative importance of New York and New Orleans for the handling of export traffic originating in the Chicago and St. Louis areas. The effect of New Orleans on Baltimore's export traffic is seen in the territory west and southwest of a line drawn in general from Chicago through Indianapolis, Cincinnati, and back to Louisville, Kentucky, west of which New Orleans has a rate advantage relative to Baltimore.

IMPORT TRAFFIC

The inland destinations of railroad carload traffic of a general cargo nature, imported through Philadelphia, New York, Baltimore, and New Orleans, are shown in Figures 5, 6, 7, and 8, respectively, and are detailed on a state by state basis in Table 2. Since the import hinterland map for the port of New Orleans on the same base as the export map does not show the full extent of importing points, a supplemental map showing all New Orleans importing destinations for the entire United States for the same sample period is included (Fig. 9).

Many of the comments made with respect to the areal extent and relative dominance of the general cargo export hinterlands of New York, Baltimore, and New Orleans apply also to the import general cargo hinterlands of the same ports. The spatial patterns formed by the hinterland termination points for general cargo imported through New York, Baltimore, and New Orleans are fundamentally similar to the spatial patterns of the points dispatching general cargo export traffic through the same ports, although many of the specific termination points are different from the points of origin. The one major exception is Philadelphia.

Whereas Philadelphia's export hinterland is very restricted in area, its import hinterland reaches far into the interior of the continent. In terms of area of dominance Philadelphia fares little better as a general cargo importer than as an exporter. Its predominance is similarly centered in the Delaware estuary complex of cities, although its dominance does extend a little farther afield in southeastern Pennsylavnia than is the case with exports. It is shaded slightly by Baltimore in the handling of consignments to western Pennsylvania destinations, where Baltimore's lead appears to be due to the concentration at that port of

much of the fabricated steel imports from Europe, at the identical terminals which handle the large volume of outbound steel. Westward from the eastern boundary of Ohio, Philadelphia first equals, then surpasses Baltimore in import handlings. By the time western Indiana, Illinois, and Wisconsin are reached, Philadelphia clearly predominates over Baltimore, and the situation is quite the reverse of that for export traffic. The bases for these differences are complex, but include several of the general factors discussed below. As a result of the activity of both Philadelphia and Baltimore as importers for the Middle West, New York's share of the total proportion of Middle Western imports moving through the North Atlantic range of ports is smaller than in the case of exports from the same area.

The eastern seaboard areas for which Baltimore and Philadelphia handle imports are less clearly defined than they are for exports. Imports arriving at Baltimore are railed to both the Philadelphia and New York metropolitan areas, as well as beyond into New England, while Philadelphia likewise invades the New York and New England areas with its imports. Philadelphia and Baltimore similarly handle appreciable import shipments destined for points in the South Atlantic group of states. While New York imports carload freight destined for a wide range of points up and down the Atlantic Seaboard states, it divides a greater share of New England's import trade with Boston than is the case with export trade. This tendency for the North Atlantic ports to handle imports for a wide scatter of destina-

TABLE 2.—TOTAL GENERAL CARGO IMPORTS, BY STATES, THROUGH THE PORTS OF NEW YORK, PHILADELPHIA, BALTIMORE, AND NEW ORLEANS, JUNE, 1955[1]
(Quantities in carloads)

Importing State	New York	Philadelphia	Baltimore	New Orleans
New England				
Maine	7	1	—	—
New Hampshire	11	—	—	—
Vermont	28	2	—	—
Massachusetts	105	8	9	—
Rhode Island	8	1	—	—
Connecticut	42	11	2	—
Middle Atlantic				
New York	820	94	56	26
New Jersey	550	109	12	—
Pennsylvania	340	1021	275	71
East North Central				
Ohio	529	90	223	173
Indiana	125	16	22	151
Illinois	372	51	26	675
Michigan	277	38	78	167
Wisconsin	126	13	3	196
South Atlantic				
Delaware	5	9	5	2
Maryland	41	9	261	—
District of Columbia	2	—	16	—
Virginia	13	10	58	—
West Virginia	24	18	34	18
North Carolina	13	3	22	2
South Carolina	32	2	3	—
Georgia	6	6	7	25
Florida	11	—	1	15
East South Central				
Kentucky	8	—	6	136
Tennessee	30	4	7	410
Alabama	14	—	9	60
Mississippi	4	6	—	124
West North Central				
Minnesota	24	6	1	253
Iowa	16	5	—	185
Missouri	42	13	3	340
North Dakota	5	1	—	28
South Dakota	3	1	—	14
Nebraska	7	—	—	140
Kansas	61	—	—	79
West South Central				
Arkansas	2	—	—	25
Louisiana	3	—	1	1077
Oklahoma	1	1	—	25
Texas	16	4	—	180
Mountain				
Montana	2	—	—	4
Wyoming	—	—	—	1
Colorado	13	—	—	14
New Mexico	—	—	—	1
Idaho	2	—	—	—
Utah	—	—	—	1
Arizona	—	—	—	—
Nevada	—	—	—	—
Pacific				
Washington	4	—	—	—
Oregon	1	—	—	—
California	34	—	—	6
Canada				
Nova Scotia	2	—	—	—
New Brunswick	1	—	—	—
Quebec	137	1	2	—
Ontario	225	24	5	20
Manitoba	2	—	—	8
Saskatchewan	1	—	—	5
Alberta	1	—	—	5
British Columbia	—	—	—	—
Mexico	1	—	—	—
Total	4149	1651	1,147	4,663

[1] Table subject to same statistical limitations as noted for the maps. See text footnote 3 for source.

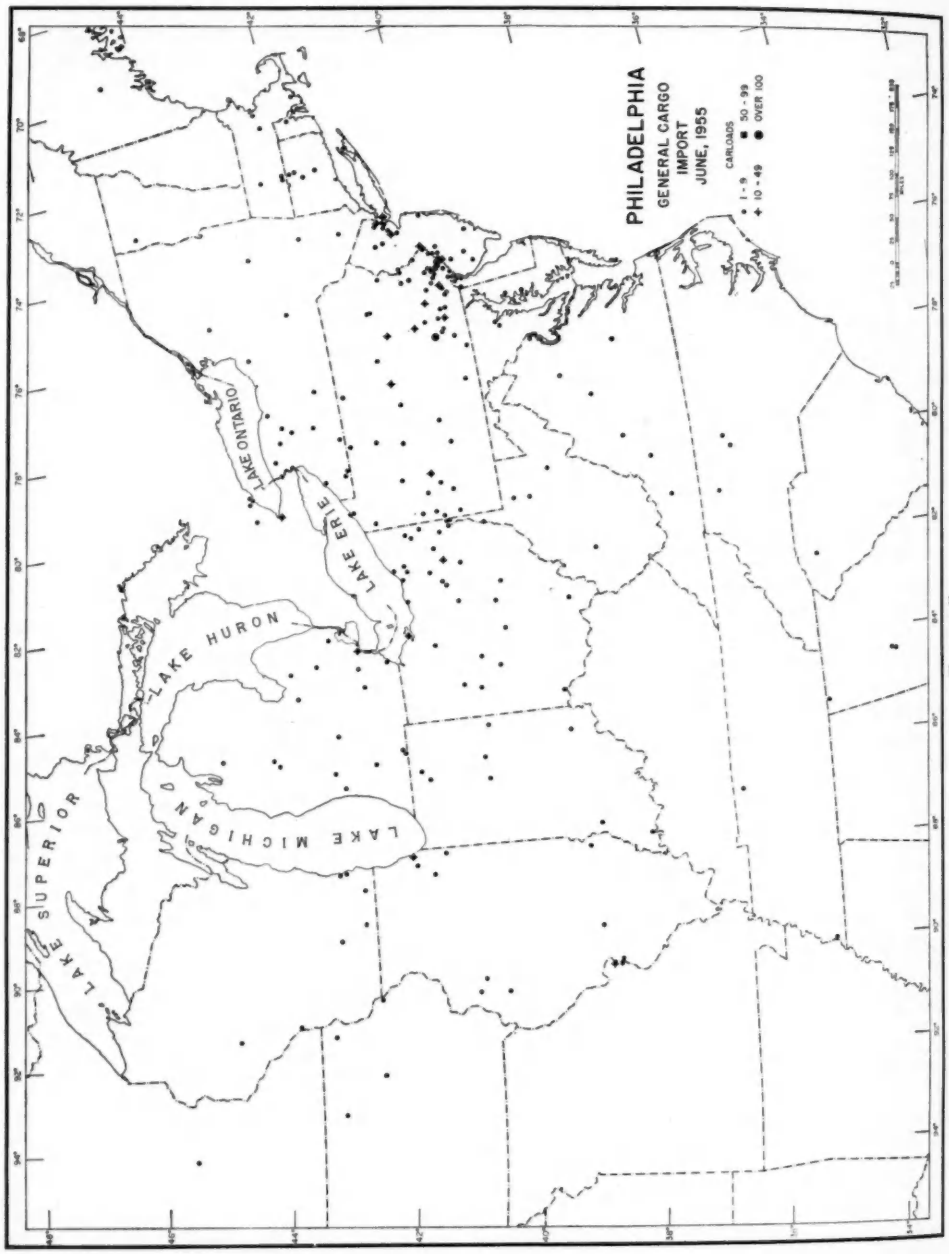

PHILADELPHIA
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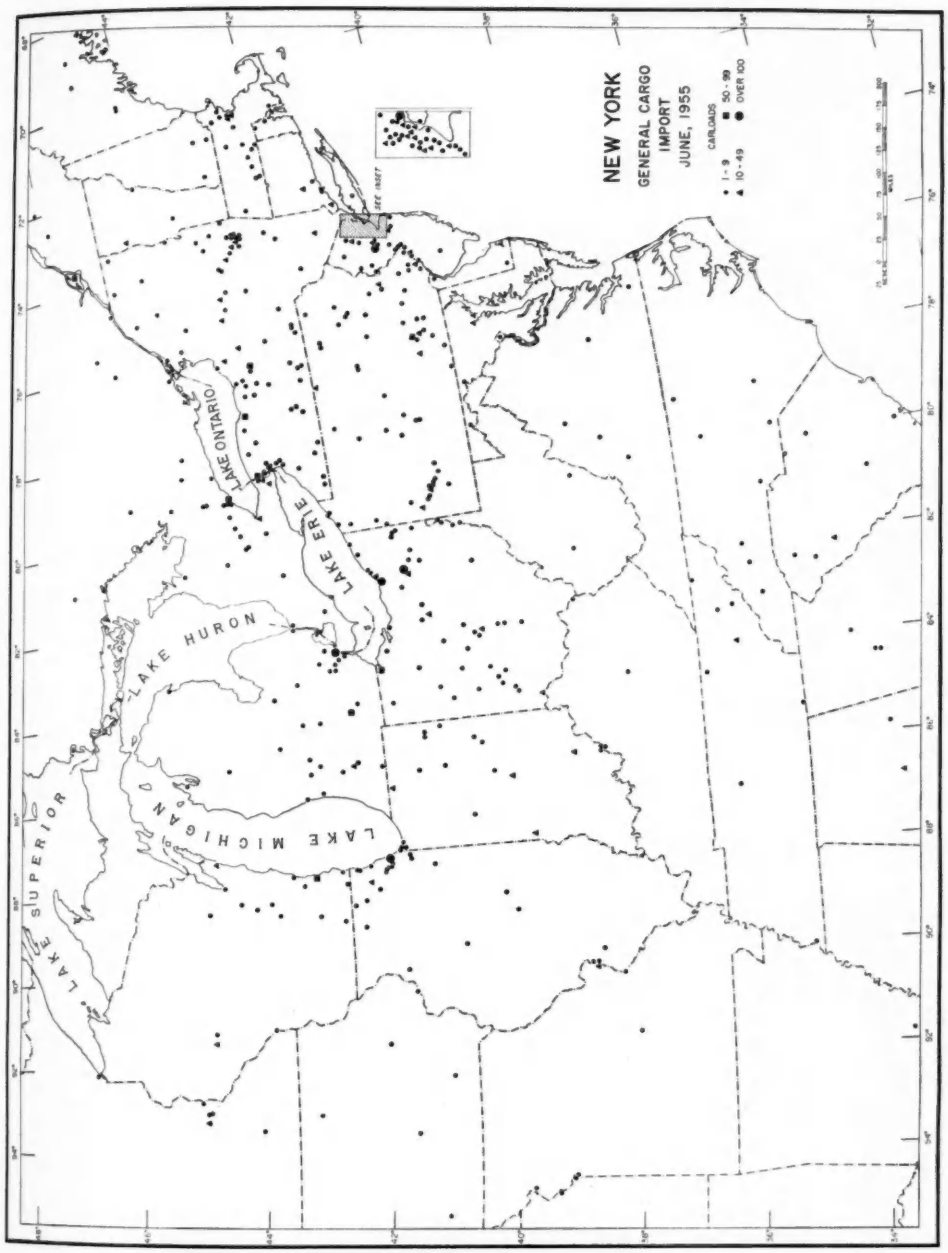
FIGURE 5


NEW YORK
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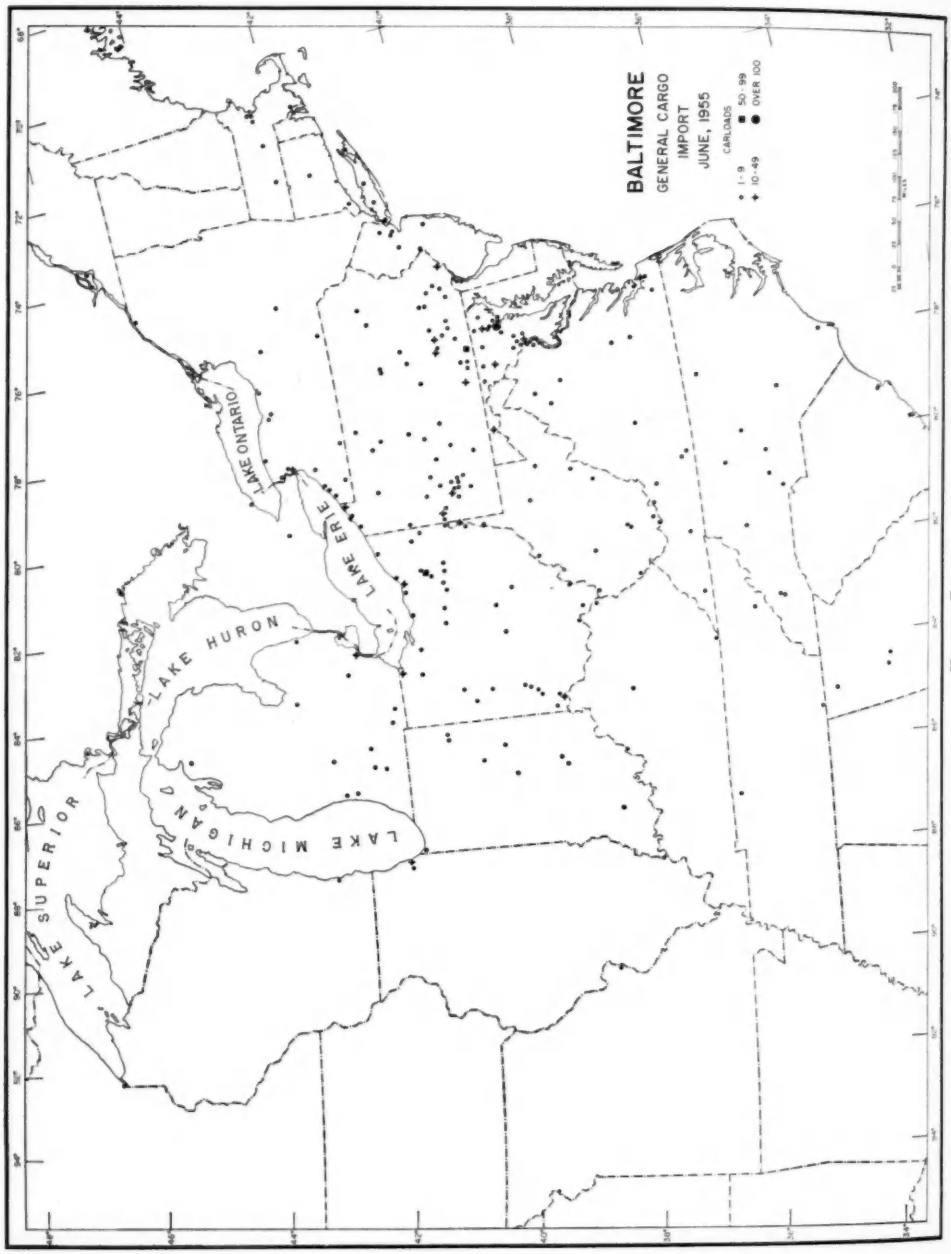
LAKE SUPERIOR

FIGURE 6


BALTIMORE
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CARLOADS
1-9
10-49
50-99
OVER 100
LAKE ONTARIO
LAKE ERIE
LAKE HURON
LAKE MICHIGAN
LAKE SUPERIOR

FIGURE 7

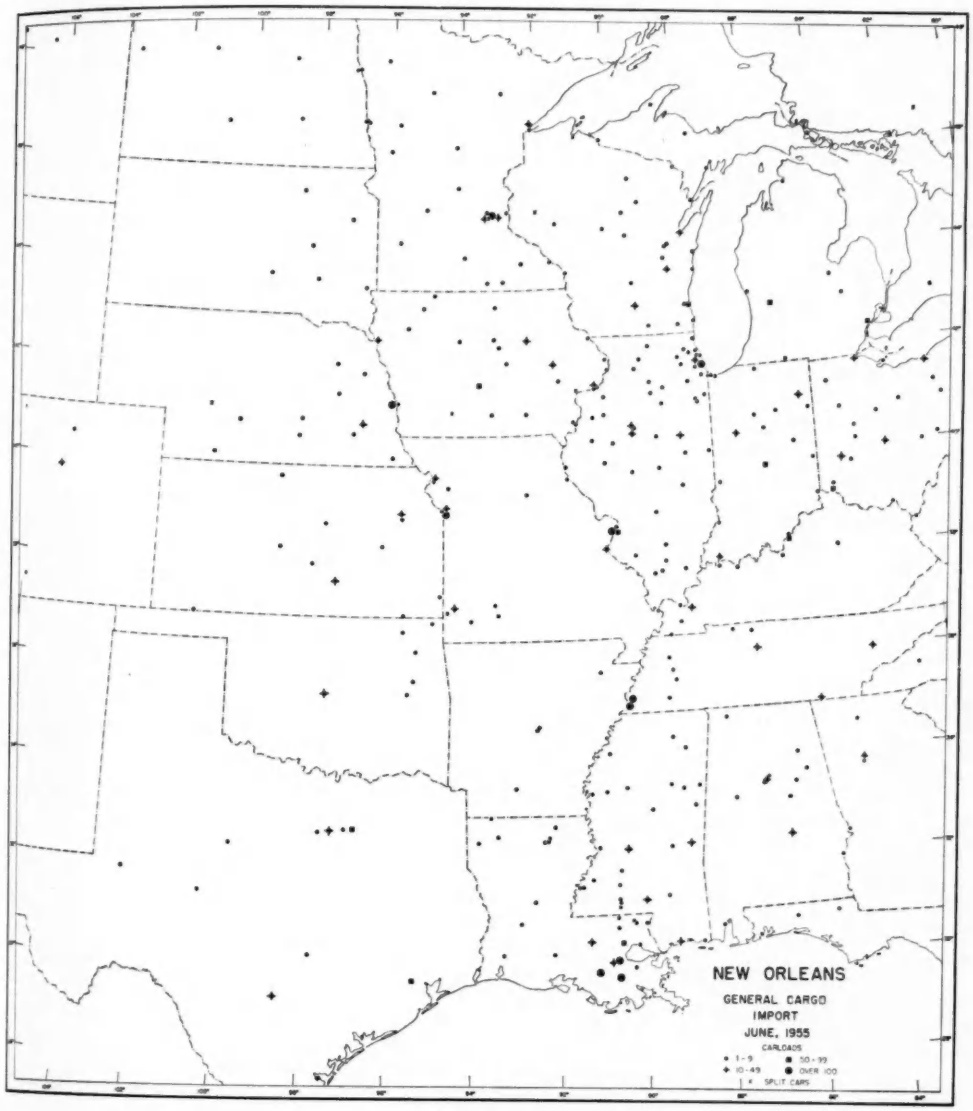
NEW ORLEANS
GENERAL CARGO
IMPORT
JUNE, 1955
CARLOADS
1 - 9
10 - 49
50 - 99
OVER 100
X SPLIT CARS

FIGURE 8

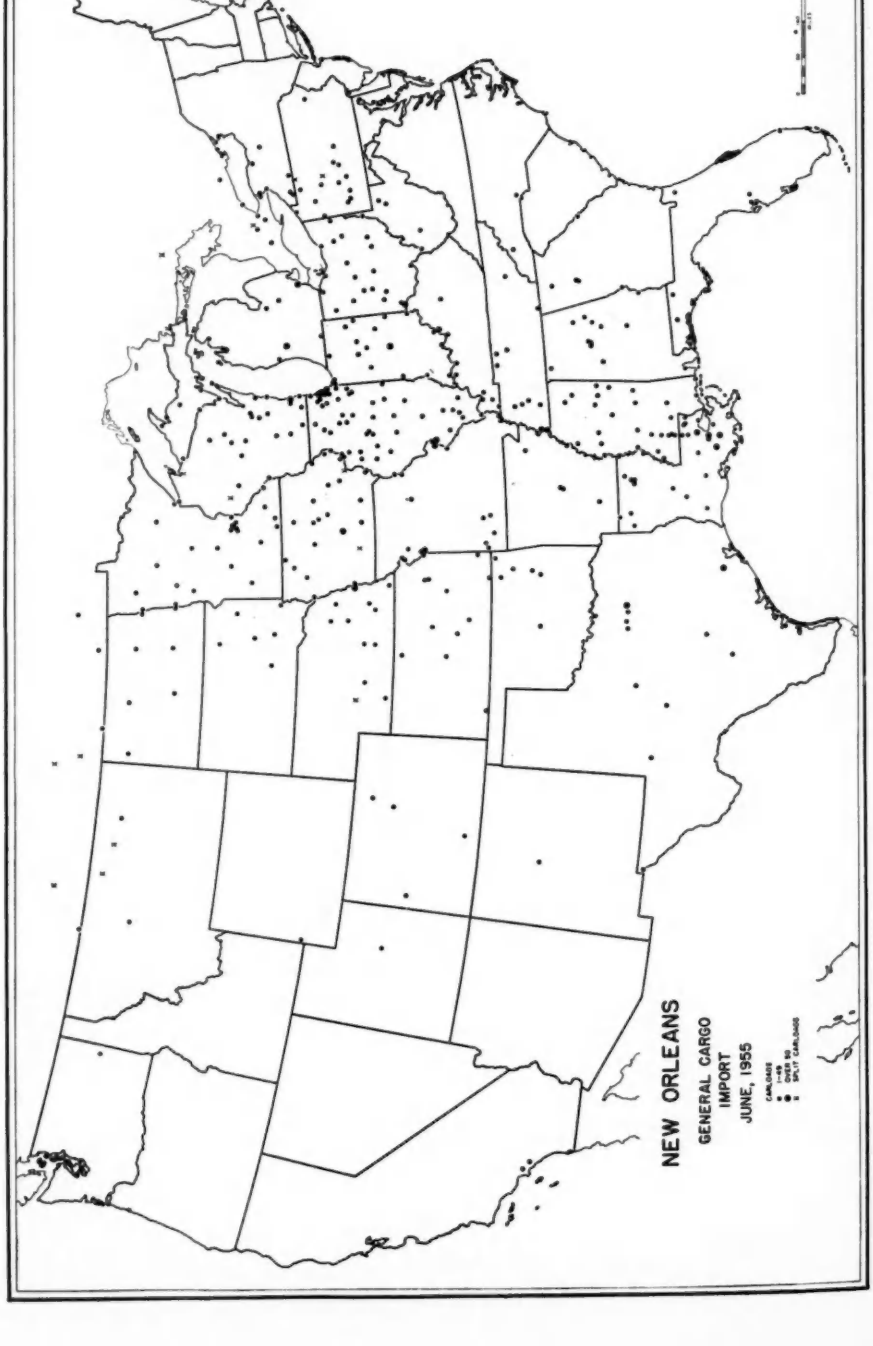

FIGURE 9

tions up and down the Atlantic Seaboard appears to be due in part to commercial organizations and physical facilities which exist at each of the ports with respect to particular raw material imports. For example, the growing woolen textile industry of the Carolina Piedmont draws most of its wool imports via Philadelphia rather than Baltimore, Norfolk, or Charleston due to the woolen industry already established at Philadelphia, and the consequent existence there of established wool brokerage. Philadelphia similarly shares with Portland, Maine, much of the china clay import of the United States.

Figure 6 indicates that New York has relatively important forwardings of imports to Montreal as well as southern Ontario. These are in considerable measure shipments of southeast Asian tropical products transported westbound in cargo liners calling at the North Atlantic range of ports but not ascending the St. Lawrence. Most of the Canadian importation of these commodities is via Halifax or New York.

A comparison of Figures 2 and 6 will indicate the generally smaller importance of New York as an importer for much of the Middle West compared to its role as an exporter. The disparity reflects the greater relative diversion of important raw materials and foodstuffs to other ports which have increasingly specialized and attracted such commodities. This trend has been encouraged by the growth of commodity markets in other ports than New York, and is partly responsible for the secular decline which has characterized New York's share of total national imports.

The general cargo import hinterland of New Orleans is even more extensive in area than its export hinterland, reaching northeastward into western Pennsylvania and western New York state and northwestward into the northern Great Plains. Two commodities imported in large quantities at New Orleans, bananas and coffee, are primarily responsible for the ability of New Orleans to command import shipments to the far-flung peripheral segments of its hinterland. New Orleans imports forwarded to western New York and Pennsylvania, Ontario, Minnesota, the Dakotas, and Montana are primarily bananas. From western Ohio westward to Nebraska and Kansas, however, the variety of goods represented by the import map is much greater. Carload traffic into the Chicago area from New Orleans, for example, is composed of close to one hundred different categories of freight.

The import territory of New Orleans cuts across the overlapping hinterlands of New York, Philadelphia, and Baltimore in a wide swath in the eastern portion of the Middle West. A quadruple overlap occurs in southern Michigan, northern Ohio, western Pennsylvania, and in parts of northern and eastern Indiana and in the Chicago metropolitan area. New Orleans import territory overlaps with that of New York and Philadelphia in Wisconsin and southern Minnesota as well, in an area where Baltimore hardly enters the picture. In the Chicago metropolitan region, New Orleans clearly surpasses Baltimore and Philadelphia in total import forwarding, and is approximately on a par with New York. It is evident that all of the North Atlantic ports are vitally affected by the ability of New Orleans to command a very sizeable share of the foreign traffic of the central portion of the United States.

SOME FACTORS IN THE SPATIAL PATTERNS OF THE PORT HINTERLANDS

It may be useful to take a broader view of factors, previously alluded to, which shape the general cargo export and import hinterlands of New York, Philadelphia, Baltimore, and New Orleans, although quantitative assessment of the relative importance of each factor is not possible, at least at present, in the enormously complex tangle of traffic movements to and from the ports in eastern North America.[7]

Port differentials may work persuasively in support of a port. Particularly is this true of bulk traffic moving under commodity rates. The more extensive export general cargo hinterland of Baltimore compared with Philadelphia would appear to be encouraged in part by Baltimore's average differential of one cent per hundred pounds below Philadelphia and three cents per hundred pounds below New York on freight moving from a tariff area generally co-extensive with the eastern Middle West.[8] Figure 10 shows Baltimore's export and import differentials with respect to other

[7] A detailed port-by-port analysis of these factors will be undertaken in other publications.

[8] These differentials are not uniformly present for all types of freight moving through Baltimore.

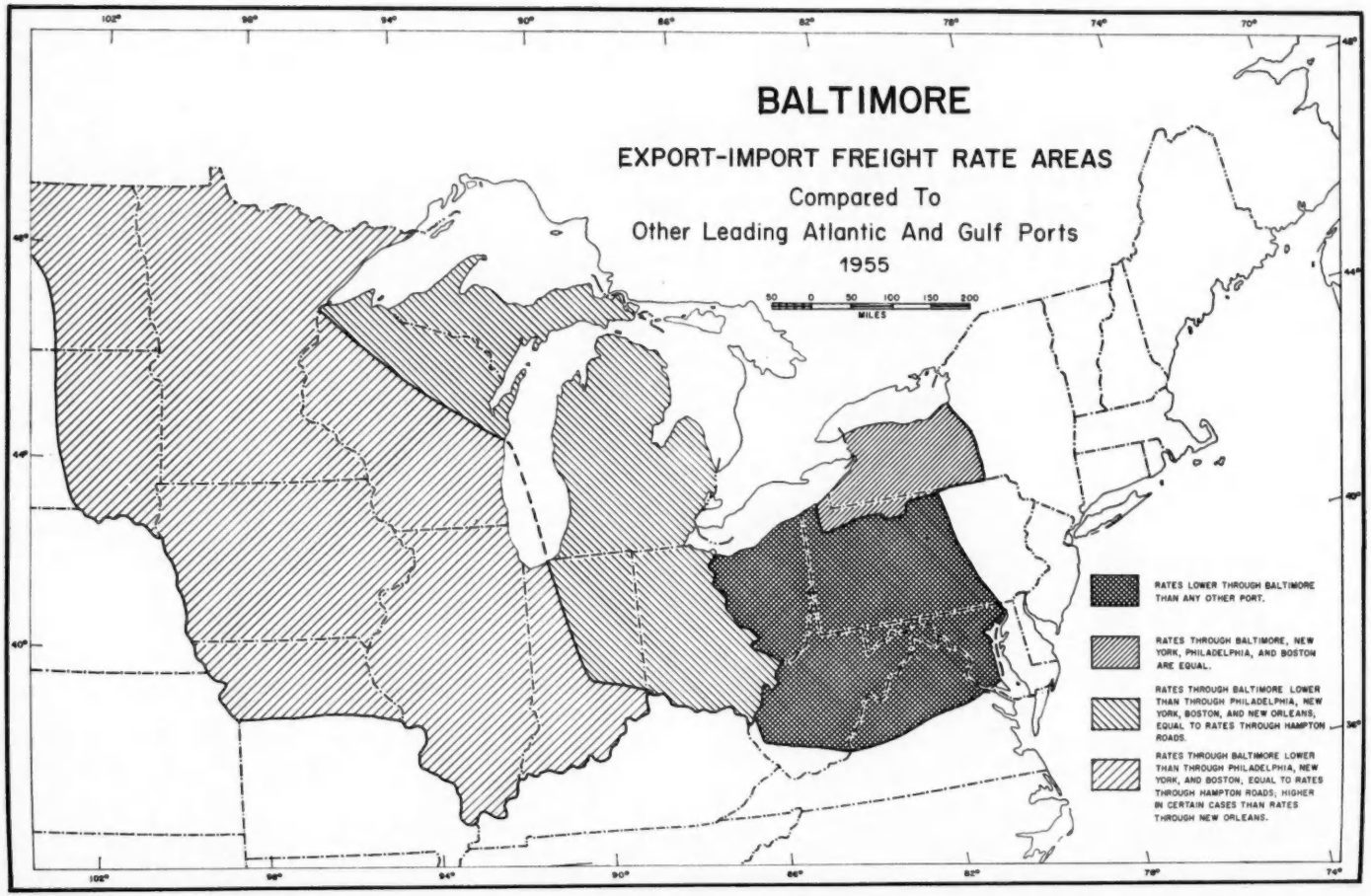
BALTIMORE
EXPORT-IMPORT FREIGHT RATE AREAS
Compared To
Other Leading Atlantic And Gulf Ports
1955
50 0 50 100 150 200
MILES
RATES LOWER THROUGH BALTIMORE THAN ANY OTHER PORT.
RATES THROUGH BALTIMORE, NEW YORK, PHILADELPHIA, AND BOSTON ARE EQUAL.
RATES THROUGH BALTIMORE LOWER THAN THROUGH PHILADELPHIA, NEW YORK, BOSTON, AND NEW ORLEANS, EQUAL TO RATES THROUGH HAMPTON ROADS.
RATES THROUGH BALTIMORE LOWER THAN THROUGH PHILADELPHIA, NEW YORK, AND BOSTON, EQUAL TO RATES THROUGH HAMPTON ROADS; HIGHER IN CERTAIN CASES THAN RATES THROUGH NEW ORLEANS.

FIGURE 10

North Atlantic ports.[9] The growing strength of New Orleans in parts of the central Middle West located generally west of a line running from Chicago through Indianapolis and Cincinnati and back to Louisville is clearly associated with rate advantages initially secured by New Orleans at the expense of North Atlantic ports as an outcome of the Knott–Todd Award early in the twentieth century.[10] At that time the Gulf ports, including New Orleans, were at a fairly low ebb. Cotton exports to Europe were active, but the earlier flow of Middle Western exports via the Mississippi had long since ceased. Lower export and import rates were designed to give north–south rail carriers at least some share of the export traffic to Europe, traffic which would otherwise move through North Atlantic ports because of route circuity and other disadvantages via Gulf ports. Since that period cargo liner service to and from New Orleans has been vastly improved; trans-Atlantic service to African ports has become appreciable, and substantial general cargo movements between the central Middle West and trans-Atlantic ports are now routed via New Orleans.

Port organizations, however, tend to overemphasize the importance of port differentials in shaping the general cargo hinterlands of ports. Not only is New York, which has a scant rate advantage territory, a standing refutation of the view of the major importance of port differentials as determinants of port traffic; other examples of general cargo not moving consequent to rate advantages include the importation of bananas via New Orleans to numerous destinations in western Pennsylvania and western New York state and an array of imports moving into the Middle West via Philadelphia.

The nature of cargo liner services is of vital importance—more so in many cases than port differentials—in attracting traffic to a port. The crucial aspect of cargo liner service may vary, however, from one port to another, or for different commodities within a single port. New York has the obvious advantage of a greater number of overseas connections and more frequent sailings than other North American ports, an advantage with historical roots extending 150 years into the past. For many shippers an item of still greater importance is the common practice of ships to call twice at New York, thus making it the first port of arrival, the last of departure. By contrast, Baltimore does not have a single trans-Atlantic connection for which it is the last port of call. Philadelphia's extensive import hinterland appears to be due in part to the fact that it is frequently the second port of discharge along the North Atlantic range. Philadelphia is used by many importers who prefer the combination of fairly early arrivals plus certain other advantages of cargo handling on a waterfront less congested than that of New York. At New Orleans the advantage over other Gulf ports probably stems less proportionately from the sequence of ship calls at Gulf ports—where there is a tendency, though not a particularly marked one, to make New Orleans the first port of arrival, the last port of departure—as from the superiority of its numerous connections with overseas ports compared to other Gulf ports. New Orleans, for example, is the only Gulf port offering substantial service to Australasia.

A major railroad network having a single port outlet acts as a powerful solicitor for a port. Indeed, railway solicitation is often well organized, far-flung, and relatively more effective than official port promotion in attracting traffic through a port. Thus the Illinois Central system has contributed to the resurgence of New Orleans as a general cargo port. Other trunk-line rairoads also serve to attract traffic through the port of New Orleans: the Gulf, Mobile and Ohio; the Southern; the Louisville and Nashville; the Southern Pacific; the Texas and Pacific; the Missouri Pacific; and the Kansas City Southern. The individual effect of each of these other railroads on the volume of traffic passing through New Orleans is understandably less than that of the Illinois Central, in part because most of them serve more than one port.

[9] Adapted from Knappen-Tippetts-Abbett Engineering Company, *The Port of Baltimore* (mimeographed report; New York, Dec. 1954), p. III–2.

[10] Interstate Commerce Commission Docket 12798, Daspit Exhibit No. 154, New York, October 29, 1907; Interstate Commerce Commission, Fourth Section Application No. 2040 *et al.*, "Export and Import Rates to and from South Atlantic and Gulf Ports," Vol. 169, November–December 1930, pp. 13–79; Interstate Commerce Commission, Investigation and Suspension Docket No. 3718, "Export and Import Rates to and from Southern Ports," Vol. 205, October 1934–January 1935, pp. 511–62.

The Pennsylvania Railroad, in contrast to the Illinois Central, could hardly be expected to favor any one port, since it serves four major east coast port areas, and an understandable neutralism is observed.[11] The Reading Railway system, the second major railroad serving Philadelphia along with the Pennsylvania Railroad, provides more active solicitation for the port, although the efficacy of the Reading in this respect is reduced by the fact that its network does not extend inland beyond central Pennsylvania.

The extensive Baltimore and Ohio system with its principal seaboard outlet at Baltimore serves to attract traffic through that port. The much shorter Western Maryland railroad, terminating inland at Connellsville, Pennsylvania, as well as at several points in West Virginia, also provides very appreciable solicitation for Baltimore, based in part on the fact that through its Connellsville interchange with the Pittsburgh and Lake Erie Railroad the Western Maryland handles a considerable volume of general cargo traffic bound to and from points west and northwest of Connellsville.

The port of New York naturally possesses the greatest array of roads which have their exclusive east coast terminal at that continental outlet, including the Erie, the Lehigh Valley, and the Delaware, Lackawanna, and Western lines, serving the area between New York and Buffalo. The Erie, which extends west to Chicago, also carries large amounts of general freight between the Middle West and New York harbor. These three roads share in the general cargo traffic moving to and from peninsular Ontario across the Niagara frontier, while the Lehigh Valley and the Delaware, Lackawanna and Western lines share appreciably in the handling of Middle Western traffic bound to and from the port of New York through their interchange arrangements with inland railroad lines. Finally, among the major railroads serving New York, the New York Central has its major outlet at New York and solicits foreign traffic in central New York state, southern Ontario, and the eastern Middle West.

The degree of efficiency reached by port terminal operations is an important consideration in the routing of traffic, but it is difficult to evaluate. Some evidence exists, too, that damage and losses of general cargo on the New York waterfront from time to time have diverted some general cargo moving to and from inland points to other ports. Both Philadelphia and Baltimore would appear to benefit from these diversions.

The structure of industry in the port itself has direct repercussions on port traffic. The relationship between the woolen industry in Philadelphia and the importation of raw wool by Carolina Piedmont woolen mills via Philadelphia has been noted. The export over Baltimore general cargo piers of fabricated steel produced at the east coast's largest steel plant, at Sparrow's Point, Md., has in turn encouraged overseas importers to supplement their steel orders at the Sparrow's Point works by further orders placed with inland iron and steel centers, particularly those in the Pittsburgh and Youngstown area. Steel products from inland producing points are thus consolidated with Sparrow's Point steel at shipside. Furthermore, ships calling at Baltimore piers are at or near the beginning of their loadings at the east coast range of ports, and thus stowage conditions are favorable for taking on steel products, which must be stowed well and down.

The growing import of bauxite and the increase in the alumina industry of the Gulf Coast similarly has provided a fleet of bauxite carriers which become general cargo carriers for the return journeys to Latin America, offering frequent sailings from New Orleans to an impressive array of ports. To this may be added the acceleration of area development programs in Latin America, necessitating flows of such equipment as oil drilling machinery from the mid-continent oil province—particularly Tulsa—and earth moving machinery from the Middle West—particularly Peoria—to these areas via New Orleans.

Of all the factors which help New York conserve its dominance in port activity, and its truly continental hinterland, none is more persuasive than the magnitude and the articulation of the commercial and financial organization back of the port. Into the combined hands of steamship agencies, freight forwarders and customs house brokers fall the traffic accounts

[11] This includes the Hampton Roads port area, however, which the Pennsylvania Railroad reaches only through its Delmarva Peninsula line extending south from Wilmington, Delaware, to Cape Charles.

of hundreds of interior manufacturers, retailers, wholesalers, and importers, for whom import and export via any one of a number of ports would be eminently feasible. Although the forwarders, brokers, and steamship agencies frequently have branch offices in other ports, their tendency is to route their client's traffic through New York, site of the home office, failing a specific request by the shipper to use another port. This factor in turn has a reciprocal effect on the scheduling of still further steamship service to and from New York.

Established commodity markets can have a conservative effect on a port's traffic, and in turn on its hinterland relations. The relatively entrenched position of the New York coffee market is a case in point. On the other hand, the gradual growth of a commodity market, such as that of coffee at New Orleans, has encouraged a widening radius of coffee distribution through that city's import houses, and has correspondingly strengthened that segment of the New Orleans hinterland in the south central and central part of the United States.

Neither the direct nor the ancillary effects of particular port structures on the attraction of traffic can be discounted. The additions to grain elevator capacity at several Gulf ports in recent years has helped to attract more shipping, with the increased opportunities available of filling out excess cargo space with grain.[12] Similarly the concentration of a large company's import functions at Philadelphia, due in part to the availability of suitable pier storage at a new facility there, has helped to extend Philadelphia's import hinterland, although the effect has been particularly significant for less than carload traffic. On the other hand, factors associated with the structure of port charges, and the nature, size, and costs of storage facilities back of the waterfront zone would appear to have subordinate roles in the shaping of port hinterlands.[13] Traffic will tend to flow in spite of unfavorable elements in the schedule of port charges, provided that commerce through the port proves attractive on other accounts.

[12] The capacity of the New Orleans elevator is 5,122,000 bushels.

SOME PROBLEMS IN THE FIELD OF PORT ANALYSIS

A series of problems are implicit in the size and spatial patterns of the general cargo hinterlands delineated on the accompanying maps. Brief mention may be made of three of these broad problems.

First, the symbols on the export maps depict continental points at which the final continuous export movements begin; those on the import maps, the initial inland point of consignment. How would the spatial patterns of the "ultimate" export and import hinterlands differ from these? How can further research toward the delineation of these North American hinterlands be pursued? Secondly, what modifications of hinterland maps would be involved if the origins of domestic traffic flows of raw materials and semimanufactured goods to the ports for further manufacture or for assembly before export were included? The other facet of the same problem occurs in the case of imports which proceed inland as domestic shipments after processing in the port areas. Third, if a port represents a form of nodality produced by the convergence of continental and maritime traffic flows, what are the characteristic features of port nodality? What are the essential similarities and differences between port and urban nodality? What relations between ports and inland nodes exist in connection with the continental flows of commodities to and from the ports? Can a useful model of these latter relationships be formulated?

Such questions help to define some further objectives of hinterland research.

[13] In spite of the numerous complaints, the general consensus of a large number of port officials in various capacities interviewed was that traffic flows through a port area in spite of any unfavorable features of either port charges or port area storage facilities.

LETTERS AND COMMENTS ON *ANNALS* TOPICS

Letters and comments on *Annals* topics are welcome. Statements should be concise, restrained, helpful, and deal with *Annals* subject matter. The Editor reserves the right to accept or reject material out of hand and to make such changes as seem necessary or becoming. This feature will be run as often as available material warrants.

THE EDITOR

THE DISTINCTION BETWEEN RELATIVE AND ABSOLUTE FREQUENCIES IN USING CHI SQUARE FOR REGIONAL ANALYSIS

LEONARD ZOBLER
Barnard College, Columbia University

A critical comment by J. Ross Mackay on my use of acre frequencies to test for regional homogeneity by the use of chi square has appeared in a recent issue of the *Annals*.[1] Because he regards acres as relative numbers, since area may also be measured by square miles, hectares, etc., Mackay finds the conclusions of that part of my study invalid.[2] He claims to find support for his distinction between relative and absolute numbers in a text by Mills[3] and states that in the application of the chi square test the frequencies used must be absolute, not relative.

It is pertinent to quote more fully from the text than did Mackay in order to understand Mills's distinction between absolute and relative frequencies. In summarizing some of the conditions attached to the use of chi square, Mills makes the following remarks:

> In applying the chi square test, the frequencies used must be absolute, not relative. If we know the total N to which given relative frequencies apply, these may of course be changed to absolute frequencies. (The reason for this condition is obvious: the significance of a given divergence of f_0 from f depends on the absolute magnitude of f. The divergence of 4 from 3 may be negligible, the divergence of 400 from 300, which is the same in relative terms, may be highly significant.)[4]

The key to Mills's meaning is the sentence which states that relative frequencies can be converted to absolute frequencies if we know the total N or number of items. "Relative" as used by Mills does not refer to the units by which the raw data were counted, but to the treatment of the raw data so as to give them a relative expression. The data are no longer absolute frequency counts, but have been converted to relative frequencies when they have been divided by N. These relative frequencies are now ratios, percents, or probabilities of occurrences. Tables 15-3, 15-4, and 15-5 and the accompanying explanation on pages 517–22 make the point clear that a relative frequency table tells one in what percentage of repeated experiments various ranges of values of chi square could be expected to occur.

Mackay is right when he says that chi square requires the use of absolute frequencies but is in error when he regards the convertibility of various units of areas the same as Mills's idea of relative frequencies. Mills is talking about the frequency of occurrence of a given event expressed in terms relative to the occurrence of all events. How is an independent observation made on one acre having a certain characteristic expressed relative to the total number of acres observed? Only by giving it a frequency of occurrence in terms of the total number of occurrences. As long as the data used are counts of one-acre units they are absolute observed frequencies. Since chi square is an operation for directly comparing two distributions, the data used must be absolute or as observed.

In order to establish that units of mensuration are relative Mackay works through an example using acre frequencies and square mile frequencies. The results disagree. Which chi square is valid? The use of square-mile frequencies runs into some unmentioned operational difficulties. The results are questionable because theoretical cell frequencies less than 10 are generally regarded as inadequate; Mackay was working with a frequency of one. Mills also notes that the larger the theoretical frequency the greater the accuracy of the test

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[1] J. Ross Mackay, "Chi Square as a Tool for Regional Studies," *Annals*, Association of American Geographers, Vol. 48 (1958), p. 164.

[2] Leonard Zobler, "Statistical Testing of Regional Boundaries," *ibid.*, Vol. 47 (1957), pp. 83–95.

[3] Frederick C. Mills, *Statistical Methods* (third ed.; Henry Holt & Co., 1955).

[4] *Ibid.*, p. 538.

and that the sample size also should not be small, some statisticians suggesting 50 as a minimum.[5] From an operational viewpoint, one should accept the results of Mackay's example which uses acre frequencies because it has a theoretical frequency of 640 and a sample size of 1280, while the analysis using square-mile frequencies has a theoretical frequency of one and a sample size of two.

There is another important point which occurs when acre frequencies are converted to square-mile frequencies. The process of assembling and organizing the data into larger units is one in which detail is destroyed. Not only are the observed values altered and different results obtained from the computation, but there is also a loss in the sensitivity of the operation. Thus, the aggregation of data into larger areal units of measurement is associated with a loss of information about the world which is under investigation. Surely, a procedure which asks us to lose information which has been gathered and is available for analysis is not the best way of expanding knowledge.[6]

Aside from these difficulties, under what conditions would it be feasible to use square miles, square kilometers, or hectares, etc., as the unit of mensuration? This depends on the design of the investigation. If the unit areas being studied are square miles or hectares, these units will be employed. The raw data will consist of counts of square miles or hectares having certain attributes. The chi square analysis would be conducted on the absolute frequencies of occurrence of the numbers of square miles or the numbers of hectares having specified characteristics.

A critical point in this discussion is, What do we mean by a relative number? Mackay's idea appears to be that a number is relative if it can be converted to another number representing the same quantity of physical things. Thus, acres are relative because they can be converted to square miles, square feet, hectares, etc. Any quantitative measurement becomes a relative, as weights may be expressed in ounces, pounds, tons, grams, etc., lengths may be expressed in inches, feet, yards, miles, kilometers, etc. Indeed, we can make all counts of objects relative in this sense by operating under rules which established a hierarchy of units; thus we can count houses singly, as farm units (3 houses), as villages (25 farm units), as towns (10 villages) etc.

It seems to me that a number is relative when it has meaning only if expressed in terms of other numbers or units. A percent is a relative number because you must ask, "Percent of what?" for it to have meaning. Dimensionless numbers are relative since they are scalar and have meaning only when compared to other numbers similarly derived.

Mackay asks me to demonstrate a theoretical basis for the selection of unit areas of one acre. This would make the frequencies absolute and validate the study. There is a strong theoretical and rational basis for using acres. The raw data were collected from large-scale maps (1:15,000, approx.), in one-acre units. Each one-acre areal unit was examined for certain attributes, classified, and counted. The sum of the frequencies thus represents the total number of observations made. The accuracy of the soil and land use maps was in the order of one acre. The acre is a widely accepted areal unit for this purpose and at this scale of measurement. It would seem irrational to use square miles or square feet. To do so, would represent a manipulation of the raw data. Indeed, the whole basis on which the testing procedures of chi square are applied to problems is a rational one. The theoretical frequency to which the observed frequency is compared is erected on some rational hypothesis.

The comments by Mackay were very pertinent and stimulated the writer to a further study of the adequacy of chi square as a tool for regional analysis. It is through the exchange of such critical ideas that improvements in the analytical techniques of geography may be achieved.

[5] Mills, *op. cit.*, p. 538.

[6] This point is made at the suggestion of William L. Garrison.

REVIEW ARTICLES

POSTWAR POPULATION MOVEMENTS IN EUROPE

Within the past decade a number of publications concerning the complex problem of European postwar migrations have appeared. They provide new understandings of population structure and changes as well as an abundance of valuable information; they are highly interesting to the geographer both for their factual content and the methods used in dealing with the changing patterns of Europe's population. Out of a large number of studies this essay will indicate only some of the more recent and significant.

Migration, defined as the physical transition of an individual or group from one society to another and from one political area to another, can be basically of two types, (1) political and (2) economic, the first caused primarily by intolerance toward racial, ethnic, or ideological groups, the second tending to reduce a demographic disequilibrium on two sides of an international boundary.

A result of the first is the refugee, defined by the United Nations convention as "one who owing to well-founded fear of being persecuted for reasons of race, religion, nationality, membership in a particular social group, or political opinion, is outside the country of his nationality and is unable or, owing to such fear, is unwilling to avail himself of the protection of that country."[1] This definition, however, does not include all types of refugees. German, Karelian, Greek, and Italian refugees, "whose flight is internal within a nation-state, members of an ethnic group returned to a 'mother country' after decades of separation, persons uprooted by famine and flood rather than by political fact, all know the condition of displacement too. . ."[2] A result of the second type of migration is the seasonal, temporary, or permanent migrant from areas of population surplus to areas of general or specific deficiency of manpower. Economic migration contributes to lessening differences between the demand and supply of international manpower.

It often is difficult to draw a clear distinction between the two types of migration. Motives for moving are the determining factors, but economic distress in an area often contributes to the flight of a refugee even though political reasons may be more important. Refugees from East Germany have been attracted to the West by better economic prospects, not only by political attractions. For both the areas of origin and of final settlement the distinction between political and economic migrants is vague, but in both economic and demographic terms they generally may be regarded as a net loss for the areas of former residence and as a net gain for the receiving country.

The most important distinction, however, may be social and psychological. The political refugee usually flees not by personal choice. The economic migrant makes a personal decision to leave his country. Only he who thinks he is able to overcome the difficulties of emigration takes the chance.

In any event, the refugee status is transitional. Sooner or later it gives way to the more permanent status of immigrant. Any formal distinction between economic immigrant and the refugee with the status of immigrant disappears, although social and psychological differences may long persist.

Studies of the migration problem have been approached by different authors from historical, political, demographic, economic, social, or psychological points of view, very seldom from the geographical one. Such studies include analysis of the areal origin of migrants, of political, social, demographic, and economic factors which affect migration, and the effects of emigration on areas of original residence. The areal distribution of migrants and their numbers and qualitative characteristics as related to the same characteristics of the indigenous population also have been studied by a number of scholars. Resettlement gives rise to problems of economic integration and social assimilation. The resulting changes in established patterns of economic and social organization may create conflicts, permit accommodation, or promote assimilation. These

[1] James M. Read, *Magna Carta for Refugees* (New York: United Nations Department of Public Information, 1953), p. 25.

[2] Richard Robbins, "The Refugee Status: Challenge and Response," *Law and Contemporary Problems*, Vol. 21 (Spring, 1956), p. 309.

processes, as studied by nongeographers, also are of high interest to the geographer as part of his concern with the areal distribution of people and functional interrelations between groups.

A number of recent studies cover some of the aspects of the migration problem within political units. They differ considerably, however, in their emphasis. The prevailing trend has been to analyze the economic and social aspects of the migrations, either the reasons for them or the factors conditioning later integration. Re-evaluations of the historical settings and careful appraisals of the available statistical material also have been carried out. However, in some cases the accuracy of provisional data has been overemphasized, and in others the authors' connections with one or another national or international organization dealing with the migration problem detract from their objectivity (e.g., Stoessinger, Proudfoot, Vernant, Zubrzycki, and some German authors).

Migrations also have frequently been considered from the purely statistical and demographic standpoint, and their human character has often been overlooked. The late United Nations High Commissioner for Refugees, Dr. G. J. van Heuven Goedhart, warned against merging the refugee problem with the so-called manpower problem on the grounds that a refugee really exists, whereas the "surplus man" is only an abstraction.[3]

With few exceptions, source materials and the studies based upon them bear the characteristics of the organizations to which they are related. They generally cover only areas, groups, and periods in which the organizations were active; seldom do they cover the whole problem. In most cases some areas, groups, and periods are omitted without explanation. Furthermore, the published statistical data are not uniform and comparable, and statistical records generally are a by-product of other administrative operations.[4] Besides limitations resulting from nonuniform methods of collection, varying systems of definition affect the data. Every international or national body has its own definition of "refugee," "expellee," "economic" or "political" migrant, and "permanent" or "temporary" immigrant. Often, unexpected reductions or increases in some statistical tables are due to changes in definition and not in the actual number of people involved. The Economic and Social Council of the United Nations has approved a series of recommendations for the improvement of international migration statistics,[5] but existing data do not generally meet the standards set forth in the recommendations.[6]

In general, the postwar statistical data are of limited accuracy. Since little control was possible in the early postwar years, false or inexact reports and registrations were not unusual. For instance, ethnically German refugees were not eligible for UNRRA and IRO support and protection. Therefore, some of them reported as nationals of the country of their previous residence, but with the end of IRO in 1951, being *Volksdeutsche* and eligible for Austrian and German citizenship but ineligible if they remained non-German refugees, many changed their previous registration. Another example is the enormous increase in the reported number of refugees in the Allied area in 1946 and in 1947, which was due to the registration of previously nonregistered, non-German refugees and not to the flight of a considerable number of new refugees from the east.

Some of the differences in statistical definitions are substantial. German refugees include refugees and expellees from outside the present boundaries of Germany with their children born after the flight or expulsion. In Austria, refugees and expellees are reported only if not naturalized. In France no special record of refugees exists. Foreigners are registered if applying for labor permits. In the Netherlands, Sweden, and in Belgium, foreign citizens are registered as immigrants. For the United

[3] G. J. van Heuven Goedhart, "The Problem of Refugees," *Académie de Droit International, Recueil des Courses*, Tome 82 (1953), pp. 261–372.

[4] United Nations, Department of Social Affairs, *Problems of Migration Statistics* ("Population Studies," No. 5 [Lake Success, New York, 1949]). See also: United Nations, Department of Economic and Social Affairs, *Analytical Bibliography of International Migration Statistics, Selected Countries, 1925–1950* ("Population Studies," No. 24 [New York, 1955]).

[5] United Nations, Statistical Office, Department of Economic Affairs, *International Migration Statistics*, ("Statistical Papers," Series M, No. 20 [New York, 1953]).

[6] United Nations, Statistical Office, Department of Economic and Social Affairs, *Demographic Yearbook 1957* (New York, 1957), pp. 42–48.

Kingdom information on continental immigration generally is not available.

General Studies

During the immediate postwar period, research and analysis were concentrated on the apparently disordered migrations in order to establish their causes, and clarify their chronology, numerical composition, and qualitative characteristics. Several comprehensive works of this sort have been prepared.

Schechtman's analysis of "the organized removal of ethnical groups, German and non-German, from their country of residence, and their subsequent resettlement in territories under the sovereignty of their ethnical homeland," is a basic reference governing the prewar and the war period.[7] Later he completed this study with a survey of the postwar population transfers in Europe[8] and prepared other articles on particular problems and new developments not covered previously,[9] among them an important study of the Polish-Soviet exchange of population.[10] Under the agreement of September, 1944, between the Lublin Polish Government and the Government of the USSR, 518,219 Ukrainians, White Russians, and Lithuanians were transferred by December, 1946, to Soviet territory, and by January, 1948, nearly one and a half million Poles and Jews had been repatriated from the former eastern Polish territories annexed to the Soviet Union. The history of this organized removal, as outlined by Schechtman, fills a major gap in our knowledge of migrations in that area.

Eugen Kulischer has carefully studied population displacements since the end of the first World War.[11] His historical summary of the changes behind the Iron Curtain is an attempt to explain the tendencies toward homogenization of populations of the eastern European countries, and of the shifting of population from east to west, which was greatly intensified by the war.[12]

Frumkin attempts to establish the exact population balances for 24 European countries.[13] He presents a reasonably precise picture of Europe's population changes since 1939, and he carefully and logically outlines his method of approach and presents his conclusions.

The most important and most comprehensive work covering the problem of international refugees is the compendium compiled by a team of fourteen investigators under the leadership of Jacques Vernant on behalf of the UN High Commission for Refugees and with the aid of the Rockefeller Foundation.[14] The study opens with a discussion of the term "refugee" and outlines the problem raised by refugees both in the receiving countries and for international agencies. The work of international bodies and the various national and ethnic groups involved in the migratory process during and after the war are discussed, and the role of the International Refugee Organization (IRO) is described in more detail. At its inception, July 1, 1947, IRO was assisting 712,000 persons; until December, 1951, more than 900,000 other refugees were registered. Of the total number of refugees living in Europe at that time (not including German, Italian, Greek, and other, noneligible refugees) over one million persons were resettled chiefly overseas, 73,000 were repatriated, 97,000 died or

[7] Joseph B. Schechtman, *European Population Transfers, 1939–1945.* ("Studies of the Institute of World Affairs" [New York: Oxford University Press, 1946]). xi and 532 pp. $5.00. For the history of the resettlement of German population from the non-German territories in the period 1939–45, see also: Robert L. Koehl, *RKFDV: German Resettlement and Population Policy 1939–1945* (Cambridge: Harvard University Press, 1957). xiv and 263 pp. $6.50.

[8] "Postwar Population Transfers in Europe: A Survey," *The Review of Politics,* Vol. XV (April, 1953), pp. 151–78.

[9] "The Elimination of German Minorities in Southeastern Europe," *Journal of Central European Affairs,* Vol. VI (July, 1946), pp. 152–66; "Resettlement of Transferred Volksdeutsche in Germany," *ibid.,* Vol. VII (October, 1947), pp. 262–84; "Compulsory Transfer of the Turkish Minority from Bulgaria," *ibid.,* Vol. XIII (July, 1952), pp. 154–69.

[10] "The Polish-Soviet Exchange of Population," *Journal of Central European Affairs,* Vol. IX (October, 1949), pp. 289–314.

[11] Eugen M. Kulischer, *The Displacement of Population in Europe* (Montreal: International Labour Office, 1943). iv and 171 pp. $1.00; *Europe on the Move: War and Population Changes, 1917–1947* (New York: Columbia University Press, 1948). vi and 377 pp. $5.00.

[12] Eugen M. Kulischer, "Population Changes Behind the Iron Curtain," *The Annals of the American Academy of Political and Social Sciences,* Vol. 271 (September, 1950), pp. 100–11.

[13] Gregory (Grzegorz) Frumkin, *Population Changes in Europe Since 1939* (New York: August M. Kelley, 1951). 191 pp. $3.75.

[14] Jacques Vernant, *The Refugee in the Post-War World* (New Haven: Yale University Press, 1953). xvi and 827 pp. $6.00.

disappeared, and the remaining 410,000 were left in the areas of IRO mandate at the demise of the organization in 1951.

The Vernant study also presents an accurate, though not uniform, survey of the legal and administrative position of refugees and their economic and social situation in 40 countries of Europe and overseas. Emphasis is on the administrative aspects of the resettlement and repatriation of so large a number of people. The study is concerned also with the refugee problem in India and Pakistan, Shanghai, and Korea. Although many factual data related to assisted migrations are presented, the individual nonassisted migration of many thousands, as well as most of the forced repatriation and nonassisted returns, are not examined. The entire group of migrants, i.e., people displaced from their usual places of residence, was not completely covered since the legal definition of refugees and the policies adopted toward them varied markedly in time and from country to country. The unadjusted statistics found in the study, therefore, are somewhat misleading. In addition, the lack of objectivity in some regional reports in the Vernant work (e.g., the chapter on Italy) results from the uncritical reporting of official statements of policy as statements of facts.

Proudfoot has contributed the most important addition to Vernant's survey.[15] His stimulating study is more uniform in presentation but less comprehensive. It outlines the history of European refugees from 1939 to 1952 and is to a certain extent a continuation of Simpson's masterly earlier work.[16] The author discussed mainly relief and rehabilitation during and after the war period until the dissolution of the IRO. Proudfoot pays special attention to the activity of the Displaced Persons Branch of the Allied Expeditionary Forces, its relation to UNRRA, and its contribution to solving the problems of displaced persons before and after the invasion of the Continent. The problem of caring for United Nations nationals is extensively discussed, but the administrative achievement of rapid repatriation is naively stressed. The tragic fate of the several hundred thousands forcibly repatriated, who disappeared in the Soviet Union or its satellite countries, is not analyzed, suggesting a striking unawareness of the complex political forces active in Europe at the time.

Proudfoot reviews the refugee problem from the standpoint of relief and rehabilitation, not of resettlement. The documentary value of his book resides in the detailed history of the refugee movement during and after the war as recorded or estimated from available evidence, within the framework of contemporary events. Based on detailed statistics and numerous unpublished documents, the book clarifies aspects of the first postwar period not discussed adequately by Vernant. However, the statistical evidence, apart from some minor errors, could be misleading in that in most cases it covers only specific topics for only a portion of the total body of migrants, and in some tables gross approximations and exact details are combined.

Nevertheless, Proudfoot succeeded in a difficult effort to combine first-hand information and personal experience with a firm handling of the general refugee question. There is, however, a gap in the historical description of migrations during the war. An account of the organized and unorganized movement across the then nonexistent international boundaries in May and June of 1945 also would have been useful, but these movements were not recorded at that time and therefore any account of them could be only approximate. Proudfoot also discusses only the civilian European refugee, omitting the military, though at that time a distinction between the two was difficult and often arbitrary. The demobilization or disbanding of military groups caused increases in the registered refugee population during 1945–47 and even afterwards. These increases, therefore, were due primarily to the registration of large groups already living in a given area and not to enlarged inflows of non-German refugees. Similarly, Proudfoot treats the Jewish and German problem separately.

The role of the international organizations dealing with the refugee problem is outlined by Stoessinger.[17] His study provides insights

[15] Malcolm J. Proudfoot, *European Refugees: 1939–1952: A Study in Forced Population Movement* (Evanston: Northwestern University Press, 1956). 542 pp. $6.50.

[16] John Hope Simpson, *The Refugee Problem: Report of a Survey* (London: Oxford University Press, 1939).

[17] John George Stoessinger, *The Refugee and the World Community* (Minneapolis: The University of Minnesota Press, 1956). 239 pp. $4.50.

into the character and activities of organizations created to deal with refugees. Little attention is paid to the refugee flows themselves, but the author emphasizes the activities of international bodies, from Nansen's appointment in 1921 to the present time. His fairly comprehensive survey of the political and social factors behind the constitutions of organizations also illustrates their shortcomings. The achievements of the IRO are stressed, possibly because of the author's personal connections with it. As in some other studies, here also the discrepancies between officially reported and known facts are sometimes substantial (e.g., the value of the IRO travel document, p. 100). Many broad generalizations hide the diversities existing in different countries in the implementation of policies; the same policies were not followed in the same way in Germany, Austria (where the differences between British, American, and French Zone were sometimes substantial), or Italy.

The legal and sociological aspect of the refugee problem is dealt with in Richard Robbins' study.[18] He illustrates the complex relationships between the status of refugee and the status of immigrant and stresses the striking transitional character of the refugee movement.

George Ginsburgs analyzes the Soviet attitude towards the problem of refugees and displaced persons from the Revolution to 1956.[19] From Soviet documents and in the light of international law, the author discusses the application of legal norms to the different groups of people claimed by the Soviet Government as Soviet citizens.

Xavier Lannes examines the apparent paradox between trends toward closer international economic co-operation and the generalized reinforcement of controls of international migration.[20] His analysis of labor shortages in the main European immigration states shows that there is now no possibility of their absorbing large manpower surpluses from other areas. Belgium, France, the United Kingdom, and Sweden have at present no manpower shortage. Belgium has some unemployment and resorts to foreign labor only for its mines. France's needs are covered by North Africans and seasonal Italian workers. The United Kingdom is open to immigrants from Ireland.[21] Potential immigrants are from southern Europe, but immigration policies condition and restrict movements. Only Denmark, Sweden, and Norway have a common manpower market (Agreement of July, 1954); there also is co-operation among Benelux countries. Despite some progress, the fear of dislocations resulting from the abolition of controls remains so strong in most countries that a common manpower market for Western Europe does not seem likely in the near future.

Proceedings of international population congresses are a mine of valuable and stimulating studies, too numerous to be surveyed here. Among them, a large part of the *Journées d'Études Européennes sur la Population* in Paris in 1953, was dedicated to migration problems.[22] The adaptation and assimilation of economic migrants and refugees in western Europe were analyzed in relation to the general economic situation and potentials of individual states. One major conclusion was that continental migrations depend on the realization of the economic integration of Europe. The mobility of European manpower is considered to be the best means for adjusting population pressure, notwithstanding the restrictive policies of governments.

At the World Population Conference in Rome in 1954[23] two meetings were dedicated to migration: one to the problems raised by migration in the areas of emigration, and another in the areas of immigration. World-

[18] Richard Robbins, *op. cit.*

[19] George Ginsburgs, "The Soviet Union and the Problem of Refugees and Displaced Persons 1917–1956," *The American Journal of International Law*, Vol. 51, No. 2 (April, 1957), pp. 325–61.

[20] Xavier Lannes, "International Mobility of Manpower in Western Europe," *International Labour Review*, Vol. 73 (January-February, 1956), pp. 1–24, 135–51. See also: Attilio Oblath, "The Problem of Surplus Manpower in Europe," *International Labour Review*, Vol. 70 (September–October, 1954), pp. 301–22.

[21] James Meenan, "Some Features of Irish Emigration," *International Labour Review*, Vol. 69 (February, 1954), pp. 126–39.

[22] Centre Européen d'Études de Population, *Études Européennes de Population, Main-d'oeuvre-Emploi-Migration. Situation et Perspectives* (Paris: L' Institut National d'Études Démographiques, 1954). 438 pp. 1000 Fr.

[23] United Nations, Department of Economic and Social Affairs, *Proceedings of the World Population Conference, Rome, 1954.* Papers: Volume II (New York, 1954), pp. 1–509; also, *ibid.*, Summary Report (1955). 207 pp.

known demographers and economists read and discussed 25 papers related to the European migration problems and covering basic economic and demographic changes, needs, and possibilities. The papers and discussions both are important sources of valuable research material.

A recently published volume on *Economics of International Migration* contains 24 studies by leading experts presented at the Seventh Conference of the International Economic Association, held at Kitzbühel in September, 1955.[24] The thoughtful analyses of the economics of migration are illustrated by reports on representative countries of emigration (Great Britain, Eire, Italy, Netherlands) and immigration (United States, Canada, Australia, South Africa, Brazil), and on intra-European movements as related to Germany, France, and Eastern Europe. The analyses of the Far East, India, Indonesia, and Israel, and the social aspects of the assimilation are presented separately. A great wealth of factual material is completed by a record of stimulating discussions of thirty-one participants of the Conference. The objective "to elucidate current trends and to deepen our understanding of the determinant and consequences of migration movements," undoubtedly was attained, especially with the debate in which different methodical approaches were discussed in a search for more valuable tools in future investigations.[25]

The Case of Germany

The countries of asylum which received the major inflow of the migrated people during and after the war were themselves overpopulated and without immediate capacity to absorb newcomers. Germany and Austria, Italy and Trieste, Sweden and Denmark received the inflow of people at the end of the war. The heterogeneity of the apparently uniform mass of people was not realized at first; it took time before the representatives of national and international organizations realized the basic diversities among them.

Among the countries of asylum Germany occupies an exceptional place. The effect of immigration or emigration on the economic and demographic structure of an area is seldom more than of local importance. In Western Germany, however, where evacuees and refugees represent 20 percent of the total population, the economic absorption of refugees became the basic economic problem; overseas resettlement never figured seriously as a solution. The demographic changes produced by the inflow were striking, and the whole human base of economic life, production and consumption, was seriously affected. Local solutions could not bring substantial results. Discussions on economic planning, demographic analyses, and financial projects, all tended to solve the "burden or stimulus of the refugee problem"[26] in theory and are recorded in a great number of substantial studies. A comprehensive plan was prepared by a mixed American and German ECA Technical Assistance Commission on the Integration of the Refugees in the German Republic.[27] The solutions adopted only partly follow the outlined plans since planning had to be adjusted to new conditions. German refugees did not come under the United Nations mandate and were not eligible for help or protection by UNRRA and IRO. They were the responsibility of the local German authorities. An exception was a group of 54,000 ethnic Germans who migrated to the United States with the help of the IRO.

At the end of the war the Allies organized

[24] Brinley Thomas (ed), *Economics of International Migration*. Proceedings of a Conference held by the International Economic Association (London: Macmillan and Co., 1958). xiii and 502 pp. 45 s.

[25] The problems of migrations are often dealt with in the major demographic reviews: *Population*, edited by the Institut National d'Études Démographiques in Paris; *Population Studies*, published by the Population Investigation Committee of the London School of Economics; and *Population Index*, edited by the Princeton Population Center. In the last-named a bibliography of current demographical publications is preceded by one or more survey articles. The following publications are concerned specifically with questions of migration: *Integration*, edited by the European Association for the Study of Refugee Problems in Munich, and the *Research Group for European Migration Problems Bulletin* in The Hague.

[26] Friedrich Edding, *The Refugees as a Burden, a Stimulus and a Challenge to the West German Economy* ("Publications of the Research Group for European Migration Problems," Vol. IV [The Hague: Martinus Nijhoff, 1951]). 53 pp. 3.50 gld.

[27] ECA Technical Assistance Commission on the Integration of the Refugees in the German Pepublic, *The Integration of Refugees into German Life*. Submitted to the Chancellor of the Federal Republic of Germany, March 21, 1951 (Washington: National Planning Association, 1951).

and carried out the removal of ethnic Germans from Poland, Czechoslovakia, and Hungary, but at the same time hundreds of thousands of ethnic Germans (*Volksdeutsche*) from other eastern and southeastern European territories were forced to evacuate. Before this organized removal, a mass of people were evacuated by the retreating German Army in the last months of the war; many others escaped on their own at the end of the war. The number of refugees in Germany was recorded with the census in 1946, when, however, the movement was still under way. Better evidence was obtained by the census in 1950, which covers, however, only West Germany. The complex problem was given special attention by the West German Ministry for Refugees (*Bundesministerium für Heimatvertriebene*). The refugees were guaranteed equality in food, housing, and employment by the laws of various states (*Länder*) and by federal laws as well. These matters are recorded in a great number of studies. Besides government agencies, various institutions (*Institut für Raumforschung; Goettinger Arbeitskreis; Verein für Sozialpolitik, Gesellschaft für Wirtschafts- und Sozialwissenschaften; Freie Universität Berlin;* and others) and many unattached persons have studied the problem carefully. Government agencies publish comprehensive and detailed statistical surveys, the federal government for all Western Germany, the states for their areas. German documents,[28] translated and summarized in English,[29] contain a detailed but one-sided account of the German evacuation and expulsion from eastern Europe during 1944–47.

A critical survey of the statistical data regarding German refugees in West Germany for the period 1950–55 is presented by Gerhard Reichling.[30] This comprehensive study starts with the census data of September, 1950, when 7,876,211 refugees were recorded in West Germany (excluding refugees from Eastern Germany). From 1950 to 1955 the number of refugees increased to 8,756,200, raising the percentage of refugees from 16.5 to 17.4 percent of the total population. West Berlin had at that time 210,000 refugees, East Germany 3,560,000. Between 1950 and 1955 great changes occurred in the areal distribution. In 1950 Bavaria had 1,937,297 refugees or 21.1 percent of the total population, the largest number but not the highest percentage of the population. North Rhine–Westphalia had in 1950 1,332,000 refugees or 10.1 percent of its population, but in 1955 it had the largest absolute number of refugees (2,081,400 or 14 percent) and passed Bavaria. Schleswig-Holstein, Lower Saxony, and Bavaria registered a reduction; meanwhile, the other states had an increase in the absolute number of refugees. Schleswig-Holstein retained, however, the highest rate: 33 percent in 1950 and 27.3 percent in 1955 (excluding refugees from East Germany), much above the average for West Germany.

Reichling examines the changes during this five-year period. The analysis of the inward and outward flow across international and state boundaries, the planned and free redistribution of refugees, their demographic characteristics, the problem of housing, the implication of religious structure of the refugee population, education, occupational distribution and social structure, employment, economic and social downgrading, economic activities of refugees in rural and industrial enterprise, all these aspects are discussed within the framework of German demographic and economic structure. The study concludes with

[28] Bundesministerium für Vertriebene, *Dokumentation der Vertreibung der Deutschen aus Ost-Mitteleuropa.*

[29] Germany, Federal Ministry for Expellees, Refugees and War Victims, *The Expulsion of the German Population from the Territories East of the Oder-Neisse Line.* Vol. I of *Documents of the Expulsion of the Germans from Eastern-Central Europe* (Bonn, n.d.) xii and 370 pp. n.p. See also: Stephen Kertesz, "The Expulsion of the Germans from Hungary: A Study in Postwar Diplomacy," *The Review of Politics,* Vol. 15, No. 2 (April, 1953), pp. 179–208.

[30] Gerhard Reichling, *Die Heimatvertriebenen im Spiegel der Statistik* ("Untersuchungen zum Deutschen Vertriebenen- und Flüchtlingsproblem, Schriften des Vereins für Sozialpolitik, Gesellschaft für Wirtschafts- und Sozialwissenschaften," Neue Folge, Band 6/III [Berlin: Duncker and Humblot, 1958]). 464 pp. DM 48. The statistical survey of the German refugee problem for the first postwar period (1946–53) was published in: Statistisches Bundesamt, *Die Vertriebenen und Flüchtlinge in der Bundesrepublik Deutschland in den Jahren 1946 bis 1953* ("Statistik der Bundesrepublik Deutschland," Band 114 [Wiesbaden: Statistisches Bundesamt, 1955]). Cf. also: Paul F. Myers and Parker W. Mauldin, *Population of the Federal Republic of Germany and West Berlin* ("U.S. Bureau of the Census, International Population Statistics Reports," Series P-90, No. 1 [Washington: U.S. Government Printing Office, 1952]).

a general survey of economic integration which was not, however, fully completed by 1955.

A number of survey articles on the postwar German refugee problem also have appeared. Harris and Wuelker draw a comprehensive and summarizing picture of the problem as it appeared after the census of 1950 and before later changes in population distribution and economic growth in the last few years.[31] The same problem is presented also in the *International Labour Review* for West Germany and Austria.[32] More recent is the survey of Roy E. Mellor, who outlines the history, distribution, integration processes, housing and occupational problems, Government policy, and the importance of refugee-owned enterprises in the last 10 years in Western Germany.[33] Chablani makes some comparisons with the Indian refugee problem;[34] he emphasizes the measures the government adopted to relieve distress and to rehabilitate the refugees. In Germany, he observes, the refugee problem always was treated as an integral part of German reconstruction and recovery; in India it was treated as a separate problem.

Dudley Kirk traces the economic and demographic changes in West Germany and gives a clear survey of the governmental policy regarding the integration.[35] He stresses the distinction between refugees (*Volksdeutsche*) who were pushed from their areas of origin, and refugees from East Germany, who pulled out to find better living and working conditions in West Germany. The author overlooks, however, the fact that the majority of the internal migrants in West Germany are not refugees.

Held has studied the fugitive nonagricultural economic enterprises in West Germany as recorded in the 1950 census.[36] He discusses their areal distribution and locational factors, and appraises these activities for their contribution to German economic recovery and the integration of refugees.

The legal status of different types of refugees in Germany is analyzed by Leo Schwarz.[37] Since the legal base adopted in different areas strongly influenced the history, distribution, and recovery of refugees, Schwarz's study is necessary background for the understanding of the complex German problem. The evaluative bibliography is of considerable value (pp. 147–168).

The most valuable recent studies are published by the *Verein für Sozialpolitik, Gesellschaft für Wirtschafts- und Sozialwissenschaften*, under the direction of Professor B. Pfister.[38] They consist of two separate series of monographs: one series deals with general problems; the other is dedicated to regional studies. The regional individualities which may be hidden in general survey studies assume their proper importance. The studies outline the reception and integration potentialities of the German states. They take into account the areal diversities resulting from economic organization, war destruction, and the policies of the occupation authorities. The different authors, although dealing with the same problems, use different approaches. Emphasis is on economic integration rather than cultural assimilation.

Seraphim presents the refugee problem in East Germany.[39] This study is an outstanding contribution to understanding the situation of the nearly four million ethnic Germans from Czechoslovakia, eastern and southeastern Europe who were resettled in East Germany by the Soviet occupants in 1944–47. The author examines the economic and social status

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[31] Chauncy D. Harris and Gabriele Wuelker, "The Refugee Problem in Germany," *Economic Geography*, Vol. 29 (January, 1953), pp. 10–25.

[32] "The Resettlement of Expellees and Refugees in the Federal Republic of Germany and Austria," *International Labour Review*, Vol. 68 (August, 1953), pp. 166–85.

[33] Roy E. Mellor, "The German Refugee Problem: Ten Years Retrospect," *The Scottish Geographical Magazine*, Vol. 73 (April, 1957), pp. 1–18.

[34] S. R. Chablani, "The Rehabilitation of Refugees in the Federal Republic of Germany," *Weltwirtschaftliches Archiv*, Band 79 (1957), pp. 281–304.

[35] Dudley Kirk, "Economic and Demographic Development in Western Germany," *Population Index*, Vol. 24 (January, 1958), pp. 3–21.

[36] Colbert C. Held, "Refugee Industries in West Germany After 1945," *Economic Geography*, Vol. 32 (October, 1956), pp. 316–35.

[37] Leo Walder Schwarz, *Refugees in Germany Today* (New York: Twayne Publishers, 1957). 172 pp. $4.00.

[38] "Untersuchungen zum Deutschen Vertriebenen- und Flüchtlingsproblem, Schriften des Vereins für Sozialpolitik, Gesellschaft für Wirtschafts- und Sozialwissenschaften," Neue Folge. Edited by Professor Dr. Bernhard Pfister. Erste Abteilung: Grundfragen; Zweite Abteilung: Einzeldarstellungen.

[39] Peter Heinz Seraphim, *Die Heimatvertriebenen in der Sowjetzone*, Band 7/I (Berlin: Duncker and Humblot, 1954). 202 pp. 23 maps. DM 15.60.

of these refugees, their numerical composition, and their areal distribution, and pays special attention to the problem of assimilation. A historical outline of Soviet policy toward the refugees is highly interesting and most valuable. The 23 illustrative charts and maps, derived from 1946 census data are very helpful, though later changes, not recorded in any census, altered the pattern to a certain extent.

In addition, each of the West German states is covered by a separate monograph based on federal census data and local statistical surveys. The refugees from East Germany generally are not included.

The industrial North Rhine–Westphalia, affected by the war-time destruction more than other areas, was not able to accept a share of refugees in proportion to its own population.[40] With economic reconstruction, however, the industrialized area was rehabilitated faster, and new housing made the acceptance of more people possible. Over one million persons, about 40 percent of them refugees, were moved into the area from less active zones by an organized resettlement program and by individual migration. The state has at present the highest absolute number of refugees and is still attracting new people from other industrial as well as rural areas. The urban center of Espelkamp-Mittwald is an example of a new urban unit created by and for refugees.

The integration in Hesse followed different lines, with the emphasis on rural resettlement and the creation of new industrial centers of which Allendorf-Neustadt is an example.[41] New industries were developed beside old ones. The increase in the refugee population was less substantial than in Westphalia, although by December, 1955, the total number of refugees had reached 811,500 or 17.7 percent of the population.

Bavaria was, from 1944 on, the refuge of Germans from the war-damaged cities of northern and western Germany and also from non-German territories.[42] It was able to accept the greatest absolute number of refugees in the first postwar years, although the prospects for absorbing them were not promising. Redistribution plans have, however, relieved Bavaria in part by transferring a large number of the nonintegrated refugees. The study also shows how population redistribution has affected the resident population. Internal movement has become to a considerable extent an expression of the general population shift from rural to urbanized and industrialized areas. A transitional stage is expressed in the large number of commuters who live in rural areas and commute to the urban centers for work.

Schleswig-Holstein has been carefully studied by Edding.[43] This rural and lightly populated area, little damaged by the war, was, because of its location and economic characteristics, a good temporary refuge for more than a million newcomers (950,300 refugees, plus 90,000 refugees from East Germany) who in 1949 made up 39 percent of the total population. The refugees were mostly from East Prussia and Pomerania. The area, however, has offered few prospects for the economic integration of so many people, despite federal subsidies for industrial development and land reclamation projects.

Bremen and Hamburg, severely damaged in the war, were unable to accept a large number of new people and at first had little to offer them in housing, employment, and economic prospects.[44] The economic structure of the two city-states, based on *Handel und Verkehr*, was considerably restricted in the postwar years. The study analyzes the economic, demographic, and social structure of the two cities. The movement of people to and from the two areas affected refugees in part only, the refugees being one-fourth of the migrants.

West Berlin, the handicapped remainder of the prosperous capital, severely damaged by the war and separated from its eastern part and from its environs, has a relatively high

[40] Gertrude Stahlberg, *Die Vertriebenen in Nordrhein-Westfalen*, Band 7/VIII (Berlin: Duncker and Humblot, 1957). 156 pp. DM 15.80.

[41] Gerhard Albrecht, *Die Wirtschaftliche Eingliederung der Heimatvertriebenen in Hessen*, Band 7/II (Berlin: Duncker and Humblot, 1954). 184 pp. DM 12.80.

[42] Bodo K. Spiethoff, *Untersuchungen zum Bayerischen Flüchtlingsproblem*, Band 7/VI (Berlin: Duncker and Humblot, 1955). 124 pp. DM 9.30.

[43] Friedrich Edding, *Die Wirtschaftliche Eingliederung der Vertriebenen und Flüchtlinge in Schleswig-Holstein*, Band 7/V (Berlin: Duncker and Humblot, 1955). 132 pp. DM 9.60.

[44] Ingeborg Esenwein-Rothe, *Die Eingliederung der Flüchtlinge in die Stadtstaaten Bremen und Hamburg*, Band 7/IV (Berlin: Duncker and Humblot, 1955). 140 pp. DM 9.80.

number of people registered as refugees.[45] They are, however, mostly former inhabitants of the larger Berlin metropolitan area who moved outside the city during the war, or people who moved to Berlin after 1939. Considered statistically as refugees, they are economically and socially part of the Berlin urbanized area without a "refugee feeling" and without special problems of adaptation and assimilation but having the same problems of economic rehabilitation as the other inhabitants of Berlin. For the refugees from outside, West Berlin is mostly a transit point on their way toward the West, the city offering few opportunities in comparison with the industrialized areas of the West.

Rhineland–Palatinate, the French zone in the postwar period, situated on the west, the first area occupied by the Allies, had a different history.[46] France did not take part in the Potsdam Agreement on the resettlement of *Volksdeutsche* from Poland, Czechoslovakia, and Hungary. Therefore, she did not consider herself obliged to accept expellees. No large group was taken into the area until the summer of 1949, and only individual refugees succeeded in settling there. Later, the planned resettlement took into consideration the absorptive capacity of the designated areas, and also the selection of refugees in order to fit the available possibilities. Experiences from other areas made it possible to avoid most of the mistakes made elsewhere and to smooth the introduction of a quarter of a million refugees and 130,000 East Germans (1955) into an area of 3,300,000 people.

Other Regional Studies

The Austrian refugee problem from 1945 to 1954 is presented in a study by Radspieler.[47] He deals with the areas of origin, statistical and demographic characteristics, legal and economic status, and the social, political, and psychological consequences of refugees in the Austrian territory. The study also includes South Tyroleans, resettled in Austria under the Hitler–Mussolini Agreement, but they cannot be considered refugees. Most German citizens were evacuated from Austria after the war; Germany also accepted from Austria 156,000 ethnic German refugees in 1946; 40,000 refugees emigrated overseas, and 160,000 ethnic German refugees have obtained Austrian citizenship. There still remained in 1954 about 330,000 foreign-born ethnic German refugees who constituted at that time about 5 percent of the total Austrian population. The final absorption of these people is quite difficult. It rests upon the legal, political, and cultural adjustments which in turn depend on the expansion of Austrian economic activities. The value of this study is increased by appendices containing statistical illustrations based on both published and unpublished material.

In northern Europe, Finland represents a special case. In connection with the boundary changes in the second World War, Karelia was evacuated and Karelian refugees resettled in Finland. The study by Axel de Gadolin is concerned with the economic integration of the evacuated population.[48] It traces the history of the first (1940) and the second (1944) evacuation from Karelia and the evacuation from the Petsamo area in 1944. It outlines the first resettlement in 1940 as well as the improved settlement plans after the second evacuation. The policy of the Finnish authorities was to settle uprooted groups as communities in new areas as similar as possible to their previous environments. The author is concerned with the effects on the relations between rural and urban populations, the ethnic (linguistic) problems in the Swedish-speaking coastal areas, land reform, and economic problems. Greater attention is given to the indemnity program and fiscal questions than to the problem of migration and resettlement.

Land reclamation programs for the new

[45] Hans Joachim Koerber, *Die Heimatvertriebenen und die Flüchtlinge aus der Sowjetzone in Westberlin*, Band 7/III (Berlin: Duncker and Humblot, 1954). 156 pp. DM 11.20. Contains also: Karl C. Thalheim, "Sonderstellung und Gesamtdeutsche Aufgabe Westberlins im Rahmen des Flüchtlingsproblems," pp. 124–32.

[46] Helmut Wagner, *Die Heimatvertriebenen und Sowjetzonenflüchtlinge in Rheinland-Pfalz*, Band 7/VII (Berlin: Duncker and Humblot, 1956). 182 pp. DM 14.80.

[47] Tony Radspieler, *The Ethnic German Refugee in Austria, 1945 to 1954* ("Studies in Social Life II.," ed. by Gunther Beijer and Julius Isaac [The Hague: Martinus Nijhoff, 1955]). xi and 197 pp. $4.00.

[48] Axel de Gadolin, *The Solution of the Karelian Refugee Problem in Finland* ("Publications of the Research Group for European Migration Problems," Vol. V [The Hague: Martinus Nijhoff, 1952]). 58 pp. 80 cents.

settlements in Finland are outlined by Mead who presents a sample study of landholding and land use in three different areas: in a borderland area in northeastern Finland (Kuusamo), in an area of central Finland (Lapinlahti), and in Porkkala, an area leased for fifty years to the Soviets in 1944 and returned to Finland in 1956.[49] From the economic point of view the reclamation of poor lands could hardly be justified, but the political decision to provide land for entire new communities prevailed. The return of the Porkkala area created unprecedented problems of an economic and political nature, since the people from that area already had been resettled elsewhere and compensated for their lost properties. The study clearly shows how the inhabited areas changed with the resettlement of refugees and how the pattern of landholdings, stable for centuries, suddenly was altered. Areas of little economic activity received flows of new people, and new economic activities began in previously retarded areas.

The study of Estonian refugees in Sweden has been under way, as communicated by Heino Tarm.[50] About 27,000 Estonians took refuge in Sweden after the fall of 1944. The survey will examine their adaptation to new conditions and the process of economic and social integration.

The United Kingdom admitted a relatively large number of refugees and economic migrants after the second World War.[51] The immigration was, except for the resettlement of the Polish Anders Army, extremely selective in order to prevent economic or employment imbalances and to eliminate displacement of British native labor. Most male immigrants were directed into mining, agriculture, and some industries; female workers were oriented toward household work.

British postwar migration has been studied by Julius Isaac,[52] widely known for his theoretical study on the *Economics of Migration*[53] as related to free individuals. Within the limits imposed by available statistics the author analyzes the demographic, economic, and social characteristics of the outward movements from Britain, conditions in the receiving countries, and the inward movement from European and non-European countries. The author examines in considerable detail postwar migration schemes and also the migration of individuals. This scholarly work is the finest and most detailed analysis and statistical evaluation available and can serve as a methodical guide for similar studies elsewhere.

One national group of immigrants in Britain is studied in detail by Zubrzycki, who examines the origin, formation, and evolution of the large Polish immigrant community residing permanently in Great Britain and still preserving its own cultural traditions.[54] The study presents a cross-section of the Polish community in a period of transition toward permanent residence in Britain. The author analyzes the process of adjustment and the positive and negative factors affecting it. Between three types of possible solutions to adjustment, namely assimilation, accommodation, or conflict, the author outlines how accommodation is followed by most.

The same problem was outlined recently by Brzenk, who shows in her doctoral dissertation the gradual concentration of the Poles in the industrial areas where the existence of Polish cultural institutions was an important and influential attraction.[55]

An inquiry among a small group of Estonian displaced persons in the city of Leicester describes the anti-assimilation tendency prevailing among some refugees, due more to their

[49] W. R. Mead, "The Margin of Transference in Finland's Rural Resettlement," *Tijdschrift voor Economische en Sociale Geographie*, 48th Year, No. 7/8 (July/August 1957), pp. 178–83.

[50] Heino Tarm, "Estonians in Sweden in 1953: A Preliminary Report" (Migration in Sweden, A Symposium), *Lund Studies in Geography*, Ser. B: Human Geography, No. 13 (Lund, 1957), pp. 328–30.

[51] Maud Bülbring, "Post-War Refugees in Great Britain," *Population Studies*, Volume VIII, Part II (November, 1954), pp. 99–112.

[52] Julius Isaac, *British Post-War Migration* ("The National Institute of Economic and Social Research, Occasional Papers," No. 17 [Cambridge: Cambridge University Press, 1954]). xix and 310 pp. 30 s.

[53] Julius Isaac, *Economics of Migration* (New York: Oxford University Press, 1947).

[54] Jerzy Zubrzycki, *Polish Immigrants in Britain: A Study of Adjustment* ("Studies of Social Life," III [The Hague: Martinus Nijhoff, 1956]). xix and 219 pp. $3.10.

[55] Eleanor Therese Brzenk, "The Distribution of Polish Immigrants in Great Britain," Ph.D. dissertation (Northwestern University, 1957). 258 pp.

cultural background than to the economic difficulties encountered in Great Britain.[56]

France has long been a traditional haven for political and economic refugees, and the Institut National d'Études Démographiques (I.N.E.D.) has devoted great effort to the study of them. Emphasis has been on social adaptation and cultural adjustment of the immigrants.[57]

Postwar immigration into France shows the strong influence of political factors.[58] A relatively small number of refugees were legally admitted. Statistical evidence of the migratory movements is highly generalized and is based on general census data and on the working permits issued to foreign workers. The survey of immigration from Algeria is still less complete. Algerians, being French citizens, are not recorded as foreigners and do not require special workers' permits.

In the last few years Algerians have provided cheap labor for the mines in northern France and for some industries in central France. Their immigration also has brought a large number of North Africans to Paris and Marseilles, creating social, political, and economic problems. Although there is no problem of legal naturalization, differences in religion, language, and customs make assimilation difficult. Restricted housing and segregation in work and social contacts are usual.

An inquiry carried out by the I.N.E.D. and published in 1955 reconstructs the North African migration, which resulted in a net immigration of over 300,000 people in the period 1947–54.[59] The four areas in which the majority of North Africans are concentrated are the North, Paris, Marseille, and the Loire–Rhone area. The I.N.E.D. survey describes the social conditions, demographic structure, educational patterns, and employment situation of the Africans; it points out their extreme fluctuations in number, the mobility of groups and individuals, the low rate of employment, etc. The immigrants try to preserve the cultural and social ties brought from their areas of origin. Employers tend to segregate them from other workers. The social conditions of the Africans are low since they are mostly unskilled workers in mines, construction, and heavy industry. Intermarriages with the local population, compulsory and restricted housing, and illiteracy present special social problems.

Michel studied a group of Algerian workers in the Moselle area.[60] The Africans came into an area traditionally open to foreign labor but created new problems with their demographic and cultural characteristics. They were confronted with difficult working conditions, assigned to the most dangerous, dirty, and poorly-paid work, segregated in camps, and limited in their social contacts. These conditions have prevented the stability of the workers, made difficult their training, and obstructed their adjustment to French society.

Belgium, as shown by Servaye, has for a century been a receiving country for foreign labor, mostly for its agricultural needs and its mines.[61] In the postwar period it admitted a limited number of non-German refugees from Germany and Austria, and a considerable number of Italians. The author discusses the economic and demographic effects of the immigration. The reduced mobility of the domestic labor force and its occupational structure make the hiring of foreign workers the easiest way to maintain constant production. Assimilation is slow due to cultural differences, segregation in housing and work, the

[56] G. W. Horobin, "Adjustment and Assimilation: The Displaced Person," *The Sociological Review*, New Series, Vol. 5, No. 2 (December, 1957), pp. 239–54.

[57] Jean Stoetzel and Alain Girard, *Français et Immigrés: L'Attitude Française. L'Adaptation des Italiens et des Polonais* ("Institut National d'Études Démographiques, Travaux et Documents," No. 19 [Paris: Presses Universitaires de France, 1953]). xvi and 532 pp. 900 Fr.

Institut National d'Études Démographiques. *Français et Immigrés. Nouveaux Documents sur l'Adaptation. Algériens-Italiens-Polonais. Le Service Social d'Aide aux Émigrants* ("Travaux et Documents," No. 20 [Paris: Presses Universitaires de France, 1954]). 296 pp. 800 Fr.

[58] Xavier Lannes, *L'Immigration en France depuis 1945* ("Publications of the Research Group for European Migration Problems," Vol. VIII [The Hague: Martinus Nijhoff, 1953]). 129 pp. $1.80.

[59] Institut National d'Études Démographiques, *Les Algériens en France, Étude Démographique et Sociale* ("Travaux et Documents," No. 24 [Paris: Presses Universitaires de France, 1955]). 166 pp. 600 Fr.

[60] Andrée Michel, "L'Immigration Algérienne en Moselle," *Annales de Géographie*, Tome LXV, No. 351 (Sept./Oct., 1956), pp. 341–61. See also, Ray Joanny, "Ombres et Lumières sur l'Immigration Algérienne en Lorraine," in Centre Européen d'Études de Population, *op. cit.*, pp. 365–69.

[61] Isabelle Servaye, "L'Immigration en Belgique, envisagée specialement du point de vue économique," *Bulletin de la Société Belge d'Études Géographiques*, Tome XXV, No. 2 (1956), pp. 331–71.

opposition of labor unions, and low professional qualifications.

The Netherlands has been an area of exceptionally frequent postwar emigration and immigration. The repeated waves of repatriation from Indonesia resulted in a sizeable net surplus of immigrants (both Dutchmen and 13,000 Amboinese), as described clearly in a recent report by J. H. Kraak.[62] Furthermore, the Netherlands admitted, after the war, a small number of foreign workers. Emigration overseas has partly compensated for the inward movements. A sample study of 13,000 refugees in the Netherlands presents their composition, social and legal status, and degree of assimilation.[63] It shows that assimilation is conditioned by the time spent in the Netherlands and by marriages with local residents; the contacts within their national groups delay their social assimilation.

Emigration from the Netherlands is a result of a contracted economy (loss of Indonesia), lack of land, and a rapidly growing population. To decrease the population pressure by subsidizing the emigration seems to be one of the three solutions, besides the increase of the efficiency of the economy through industrialization, and the reclamation of new lands from the sea. Emigration to other European countries, as well as to Canada, which accepted about half of the Netherlands postwar emigrants, is dealt with in numerous studies.[64] The most comprehensive is the one by Petersen who attempts to analyze the so-called "planned emigration" from the Netherlands to Canada against a background of the social history of the two countries.[65] The social, demographic, and economic conditions in the two countries "are analyzed not merely as causes of the migration between them but also as rationalizations of the group sentiments shaping this movement." The Dutch–Canadian migration also has been studied by Tuinman[66] and by Sas.[67] Sas shows the results of his field investigation in southern Ontario, the region which absorbed over 50 percent of all Dutch immigrants into Canada. The author studied the contribution of the Dutch settlers to the Canadian economy. He concludes that economic integration is taking place, but not cultural assimilation because of strong intergroup relations and the influence of church organizations which tend to foster strict adherence to Dutch traditions.

For Italy, land of emigrants to other European countries and overseas, a large number of newspaper reports and articles were published,[68] but no comprehensive study of the whole refugee problem has appeared recently. Also, the repatriation of Italian nationals from Venezia Giulia and Albania, as well as from former African possessions (480,000 persons), has only partially been evaluated. No comprehensive study is available on the last migratory flow from Zone B of the Trieste Territory (in 1954), or the re-entry of South Tyroleans who moved into Germany and Austria during the war.

Spain has special problems regarding her emigrants and refugees. The civil war caused a flight of many hundreds of thousands; in 1938 there were an estimated 650,000 Spaniards resident in France. World War II and the German occupation, however, reduced their numbers. Some of them returned to Spain; some emigrated overseas, were assimilated, or

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[62] J. H. Kraak, "The Repatriation of the Dutch from Indonesia," *Bulletin, Research Group for European Migration Problems*, Vol. 6, No. 2 (April/June, 1958), pp. 27–40.

[63] H. Verwey-Jonker and P. O. M. Brackel, *The Assimilation and Integration of Pre- and Postwar Refugees in the Netherlands* ("Publications of the Research Group for European Migration Problems," Vol. XI [The Hague: Martinus Nijhoff, 1957]). 56 pp. n.p.

[64] Centre Européen d'Études de Population, *op. cit.*, pp. 251–81, three reports by T. van den Brink, Sjoerd Groenman and Everet Willem Hofstee, and Groenman and Gunther Beijer. Also: Brinley Thomas (ed.), *op. cit.*, report on Netherlands by E. W. Hofstee. Also, William Petersen, *Some Factors Influencing Post-War Emigration from the Netherlands* ("Publications of the Research Group for European Migration Problems," Vol. VI [The Hague: Martinus Nijhoff, 1952]). xi and 80 pp. $1.15.

[65] William Petersen, *Planned Migration, the Social Determinants of the Dutch-Canadian Movement* ("Publications in Sociology and Social Institutions, University of California," Volume 2 [Berkeley and Los Angeles: University of California Press, 1955]). x and 273 pp. $3.50.

[66] A. S. Tuinman, "The Netherlands-Canadian Migration," *Tijdschrift voor Economische en Sociale Geographie*, 47th Year, No. 8 (August, 1956), pp. 181–9.

[67] Anthony Sas, "Dutch Migration to and Settlement in Canada: 1945–1955," Ph.D. dissertation (Clark University, 1957). 194 pp.

[68] See "Italian Emigration during the Period from 1946 to 1954," *Italian Affairs*, Vol. IV, No. 6 (Nov., 1955), pp. 985–95.

disappeared without trace. At the end of the war Spain accepted a small selected group of political refugees. Italians, Germans, Belgians, French, Slovaks, Yugoslavs, numerically insignificant groups, took refuge in Spain for reasons of political affinities. With the problem of her own overpopulation and economic distress, Spain provided in her turn a number of her own emigrants, mostly to South American countries.[69]

Portugal occupies an analogous position to Spain,[70] since she received only a limited and highly selected group of immigrants, and provided at the same time a constant flow of emigrants, mostly to Brazil and to the Portuguese African territories.

Greece and her migrations in the postwar period have received little attention from non-Greek scholars. The civil war in Greece caused a large displacement of the population (more than 700,000) and forced many thousands to take refuge in neighboring areas. Some of them could not return to their villages (140,000) and were resettled elsewhere.[71]

The Jewish problem, the history of refugees, extermination, flight, resettlement, economic integration, political setting, were intensively studied in the early postwar period. Their resettlement and integration extend beyond the limits of this review, however.

The resettlement of 150,000 persons of Turkish descent, expelled from Bulgaria in 1950–51 and accepted in Turkey, is described by H. L. Kostanick.[72] He covers the history of Turkish settlement in the Balkans and summarizes the political status, economic activities, and cultural and religious traditions of the Turks. After 1946 the Turkish community was forced to accept the economic and political organization of the new Bulgaria. Its characteristics were left undisturbed only so far as they were not in conflict with the new regime. The movement of people of Turkish descent from the Balkan areas to Turkey started in 1918. A special Turkish–Bulgarian Convention in 1925 established the conditions under which the voluntary migration of the Turks from Bulgaria and of the Bulgarians from Turkey could take place, but a sudden change occurred on August 10, 1950, when the Bulgarian government announced that 250,000 Turks must leave Bulgaria. By late autumn, 1951, 150,000 persons had entered Turkey; then the frontier was closed. There still remained about 600,000 people of Turkish descent in Bulgaria.

"The policy of the resettlement program in Turkey has been to integrate the immigrants into Turkish social patterns and to place them in regions where they can be productive members of their community on the basis of previous skills and experiences." (P. 132). Resettlement has followed previously adopted legal provisions. Land was allotted; houses were built; and whole communities were transplanted into a new environment. The problem of absorption was helped greatly by the basic similarities in language and religion between the newcomers and the resident population. Settlement was restricted to western Turkey for security reasons. Most refugees were settled near existing villages and towns. Only a few completely new villages were built. The major concentration of refugees was in the densely populated areas where economic opportunities are more favorable and where the refugees could practice their previous crafts or grow the same crops as in Bulgaria. The political nature of the expulsion influenced the "success" of the settlement program. The newcomers were accepted by the Turkish population, and they easily adapted to the new conditions. The major shortcoming of the plan was the fact that not enough land was given to all immigrants so that they found it necessary to look for additional income besides farming.

Summary

Recent studies have cast new light on the history and development of the complex move-

[69] Jesús Villar Salinas, "Mobilité géographique contemporaine de la population espagnole," in Centre Européen d'Études de Population, *op. cit.*, pp. 215–32.

[70] See Antonio do Amaral Pyrrait, "Raisons et possibilités de l'émigration portugaise," *Ibid.*, pp. 233–34.

[71] See Council of Europe, *Refugees and Surplus Elements of Population*. Report issued by a group of experts appointed by the Council of Europe to examine the problem of refugees and over-population in Europe (Strasbourg: Council of Europe, 1953), p. 119. Chapter on Greece: pp. 17–20.

[72] Huey Louis Kostanick, "Turkish Resettlement of Refugees from Bulgaria, 1950–1953," *Middle-Eastern Journal* (Winter, 1955), pp. 41–52. Also, same author, *Turkish Resettlement of Bulgarian Turks 1950–1953* ("University of California, Publications in Geography," Vol. 8, No. 2 [Berkeley and Los Angeles: University of California Press, 1957]), pp. 65–164. Plates 6–20, 1 figure in text. 4 maps. $2.50.

ments of economic and political migrants in Europe and on the problems connected with their assimilation. Most of the studies suggest research techniques which contribute to the understanding of similar problems elsewhere. However, many aspects of the complex problem remain unclear. The influence of emigration on the economic and demographic structure of the source countries as well as their influence on the receiving areas is a question barely touched upon thus far.

Few of the publications consider the migration problem in its geographical settings; most do not consider areal diversities inside national units. Frequent generalizations, too, in the demographic studies can be misleading, since problems of migration vary in intensity and characteristics from one country to another and from one section of the population to another. The areas, groups, and situations in a given period are unique; the conclusions valuable for one group are not necessarily applicable to any other. Unqualified determinism in approaching the problems of human groups is hardly acceptable to the geographer whose curiosity makes him skeptical about "laws" and "principles" which may refer only to indications of possible relations or casual associations. The area and its population, cultural characteristics, and economic conditions, the qualitative and quantitative characteristics of migrants, their diversities and affinities with the resident population give rise to as many complex patterns of relationships as there are areas and groups considered. The common denominator is simply the broad fact: people have moved into a new environment.

The human aspect, despite its essential significance, also tends to be overlooked in demographic and economic evaluations. "The human point of view should never be lost from view in any studies of migration. Migrants are not just units on the move, but human beings with desires, prejudices, preferences, and fears of their own. . . ," as H. F. Rosetti pointed out at the UN World Population Conference in Rome.[73] The element of justice, the appreciation of ethical values, of social rights and duties, are of no less importance than economic evaluations of the best areal distributions, economic potentialities, professional retraining, and social adjustment. Economic integration is not necessarily followed by social and cultural assimilation; it merely conditions it. Furthermore, superficial adaptation to the new environment does not necessarily mean that assimilation has taken place.[74]

In terms of sub-national areas much remains to be done in order to clarify population mobility and its impact on the areas involved. Also, relatively little is known about actual problems in smaller areas where the coexistence of human groups of different origin and cultures influences their interrelations and changes their traditional way of life.

The geographer is aware of the complexity of the problem; he tries to understand the detailed and intricate pattern of mobility and stability among human groups. The elements and processes of migration and integration, and their interrelation in smaller and larger areas are important phenomena, worthy objects of geographical research.

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[73] United Nations, Department of Economic and Social Affairs, *Proceedings of the World Population Conference, Rome, 1954*, Summary Report (New York, 1955), p. 161.

[74] See Maurice Edmond Perret, "Adaptation des immigrants ne signifie pas necessairement assimilation," *Revista Geográfica*, Tomo XIX, N. 45 (2° semestre de 1956), 1957, pp. 102–3 (abstract).

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RECENT PUBLICATIONS ON THE DISTRIBUTION OF POPULATION IN THE UNITED STATES

The United States has been an area of particular interest to the student of population phenomena for many reasons. The very size and importance of the national population command attention; a tremendous mass of demographic data and relevant social and economic information have accumulated for the enterprising scholar; the recency of settlement and relatively simple course of our historical development provide a pleasantly nondistracting medium for observing demographic trends that are more than adequately perplexing in themselves; and there is the presence of the largest corps of population

scientists that any nation has yet acquired. Aside from offering fertile soil for the student who is content just to describe and analyze the immediate facts, the United States has peculiar potentialities for those wishing to delve into basic population theory. Because of the comparative simplicity and directness of our cultural evolution, many principles can be detected and hypotheses tested—all of them presumably universal in validity—that are seen murkily, if at all, in lands with longer careers. Furthermore, it seems likely that, relatively straightforward as it has been, the breakneck pace of our social and economic development has propelled us into a more advanced phase than even the most prosperous of our foreign neighbors. Thus the American scene may well prove the best vantage point for charting the future population and settlement patterns of much of the world.

It is not surprising, then, that an impressive volume of literature on the American population has been appearing in recent years, much of it directed toward its areal aspects, wholly or in large part. What is attempted here is a brief survey of sixteen of the more significant book-length items published since 1950. Because of space limitations, no attempt is made to cover the extensive periodical literature on the subject.

The reader will no doubt note immediately that all but one of the contributions on this eminently geographic subject under review are from the pens of nongeographers, specifically demographers trained primarily in sociology. This ratio of 15:1 is less a product of the reviewer's whim than something of a reflection of the relative efforts expended by nongeographers and geographers in the study of American population distribution. Although work of considerable substance has come from a few individuals, such as O. E. Baker, C. Warren Thornthwaite, or Herman Friis, and more can be confidently predicted in the form of Jean Gottmann's forthcoming treatise on "Megalopolis," the geographers who have ventured into this field have been rather lonely sojourners. Even that most rudimentary chore—the preparation of a truly serviceable general population map of the country—still comes under the heading of unfinished business. The best available substitute, the Census Bureau's red and green dot map of rural and urban population in 1950, which is reproduced in *12* and *16* and also re-appears in the National Atlas (about which the less said the better), fails to meet reasonable standards of attractiveness and intelligibility. In contrast, there has been a relatively sustained program of research, much mutual interaction of ideas, and a goodly amount of collaboration among the leading demographers who have pursued distributional studies during the 1950's.

The historical and philosophical factors that help account for the reluctance of American geographers to claim what is logically a topic close to the core of their discipline were explored by Trewartha in his 1953 presidential address before the Association and need not be repeated here. Perhaps the publication of monographs such as those noted here, with their abundance of provocative ideas and only fractionally exploited statistics, will eventually stimulate a comparable or even bolder series of experiments on the part of geographers. At any rate, it is evident that, for all their zeal, demographers are handicapped in their distributional studies by a basic inability to think geographically. Similarly, the geographer's progress in the same area will be impeded by his halting acquaintance with indispensable sociological concepts. The time is ripe for symbiosis.

The need for a general descriptive account of the contemporary American population and its characteristics is adequately met by the volumes by the Taeubers and Duncan and Reiss. Both works are published as items in the Census Monograph Series, an enterprise designed to revive on a somewhat more modest scale the great succession of Census atlases and monographs that lapsed after 1920, probably because of depression and war. Although we have had the highly useful publications of the National Resources Committee, Goodrich, and Vance, and shorter contributions by others during the interim,[1] the ap-

[1] See, in particular, National Resources Committee, *The Problems of a Changing Population* (Washington, 1938); Carter Goodrich, *et al.*, *Migration and Economic Opportunity; the Report of the Study of Population Redistribution* (Philadelphia: University of Pennsylvania Press, 1936); and Rupert B. Vance, *Research Memorandum on Population Redistribution within the United States* (New York: Social Science Research Council, 1938) and *All These People; the Nation's Human Resources in the South* (Chapel Hill: University of North Carolina Press, 1945).

pearance of this new quasi-official series is most welcome; and it is devoutly to be hoped that adequate funds will be allocated in the 1960's and decennially thereafter for reports and atlases on an ampler scale.

Of the two books, the Taeuber monograph[2] is intended for the wider audience, and it can be recommended without reservation to the specialist and nonspecialist or, for that matter, to anyone in or out of the academic field with an interest in the history, present status, and trends of our population. For the geographer it offers a concise and reliable statement of what he should know about the past and present population of the United States. Even though the Taeubers have not tried to treat their material geographically, the areal factor is fully respected, and interstate or intersectional differentials for many items are presented by means of maps and tables as well as discussion. The greatest stress is naturally laid on the current scene, but spatial and social development is traced from 1790 to the present, and the authors always show a strong sense of history in dealing with residence, migration, socio-economic traits, and vital rates. There is a brief but sensible discussion of the demographic prospects for 1975. This is not an exhaustive treatise, but rather one where the writers have had to compress and summarize into rather narrow confines material culled from an enormous storehouse of facts. There is a depth and maturity, an awareness of larger forces, in this writing that lifts it well above the level of a mere anthology of statistics. The receptive reader will be well repaid for his attention.

The Duncan–Reiss contribution[3] is a monograph of another color, being essentially an advanced and original treatment of a broad range of 1950 census statistics organized around the concept of the community. Such topics as age and sex composition, race and nativity, marital and family status, mobility, education, occupation and labor force status, and income are presented for the entire American population arranged into nine levels of community size and into Census regions. The short, but interesting chapter on village population (1,000–2,499) that appears in the initial section is a welcome addition to our scanty stock of knowledge about this aspect of our population. The analysis is continued after classifying the communities, in terms of spatial organization, into metropolises, suburbs, urban fringe, independent cities, and rural population, with a special digression on the rural–urban fringe of the Chicago Standard Metropolitan Area (in rough terms, the outermost zone of that area). The third and fourth parts of the book carry on the discussion of socio-economic characteristics cross-classified by community rate of growth or decline and by the functional specialization of communities, respectively.

Geographers are likely to be most intrigued by the elaborate scheme for the functional classification of cities devised by the authors, one that is far more complex than anything offered by Harris, Alexandersson, or any other geographer and probably one that represents the practical extreme to which such classifications can be pushed. In brief, the 1,262 places which had a population of 10,000 or more in 1950 are grouped into three categories—central cities, suburbs, and independent cities—on the basis of metropolitan status and these categories are further broken down in terms of size into a total of eleven size-metropolitan status groups. Then, by means of rather refined procedures that cannot be summarized here, statistical criteria have been established independently for each of the eleven groups whereby every city is accorded a designation in terms of four functional classes: manufacturing (high, low, or neither); trade (nine varieties of retail and wholesale centers and combinations thereof); minor specialization (education, public administration, transport, military, and entertainment and recreation); and income level (four classes). The results of this highly commendable experiment are given in tabular form, but unfortunately not on maps.

It is impossible even to hint here at the profusion of findings, some stimulating, others culs-de-sac, which the Duncan–Reiss approach yields to the patient reader; but he

[2] Conrad Taeuber and Irene B. Taeuber, *The Changing Population of the United States* ("Social Science Research Council and U. S. Bureau of the Census, Census Monograph Series" [New York: John Wiley & Sons, Inc., 1958]). xi and 357 pp. $7.75.

[3] Otis Dudley Duncan and Albert J. Reiss, Jr., *Social Characteristics of Urban and Rural Communities, 1950* ("Social Science Research Council and U. S. Bureau of the Census, Census Monograph Series" [New York: John Wiley & Sons, Inc., 1956]). xviii and 421 pp. $7.50.

had better be warned that this volume, like the others covered in this review, is not hammock fodder. It is closely reasoned, tightly written, and just plain slow-going; but considering the mountain of material that has been kneaded into usable form, we are much in debt to the authors. Of the few drawbacks from which the book suffers, one is inherent in its design. This is by intention a static analysis of a population which is, in fact, in a condition of rapid flux, but any attempt to inject the temporal factor would make this work impossibly cumbersome. Because of the emphasis on the metropolitan orientation of the national population, there is a slighting of the rural, and particularly the rural–farm, population and only some half-hearted attempts to deal with it. Most serious from the geographer's viewpoint is the authors' obvious annoyance with the regional factor. It is refractory in terms of ordinary statistical analysis, and disturbs the neat ordering of generalities that many sociologists and economists strive for, since it cannot readily be reduced to a quantitative expression.

John Brush's book on the population of New Jersey,[4] the sole geographic entry on our list, is interesting not only for the contrast it provides with the primarily sociological tomes, but also because of the fact that it is one of the extremely rare book-length treatments of population thus far published by a geographer anywhere. Although this work is not quite a true population geography of the state, it is certainly a most expert discussion of New Jersey's population, set forth with a powerful geographic bias. Now in its second edition, with the addition of recently available data, the book was apparently successfully designed to meet the needs of local officials, planners, teachers, businessmen, and interested citizens, rather than the student of population theory, but it is heartily recommended to any demographer or geographer. Availing himself of only 123 pages of text, graphs, and maps, Brush has furnished us with a surprising quantity of readable, well-organized data. After describing the distribution, natural setting, demographic characteristics, and trends, urbanization, and economic organization of the state's inhabitants, he presents a careful analysis of each of his eight socio-economic regions based on field experience as well as map and tabular analysis and, finally, some projections of future conditions. His study area being what it is, Brush's monograph often seems more like urban than population geography; it is also, because of its wide-ranging nature, an admirable substitute for a definitive general geography of the state until such a book comes along.

The New Jersey boundaries impose peculiar limitations on the scope of the work. In the main, the state is one of the more isthmian tracts in the great conurbation stretching along the Atlantic Seaboard from Maine to Virginia. New Jersey cannot be understood properly without treating the geography of the entire New York City and Philadelphia metropolitan areas, and these, in turn, must be viewed from the perspective of their vast North American hinterlands. This task Brush has pointedly, and probably wisely, declined, but it would have to be included in a full-scale population geography of the state. Such a treatise would also have taken in such topics as the internal structure of the cities and an ampler treatment of the historical geography of settlement, migration, and population/resource interaction. The only other carping remarks that can be made about a book that is almost flawless within its stated limits are other matters of omission: the great mass of migrational data recently published by Bogue, Bowles, Lee, and others might have been used to considerable advantage; a welcome addition to the set of well-designed maps would have been one identifying communities classified according to Brush's functional system; and there is perhaps too little reference to the transportation factor in a state which owes much of its prosperity to its special advantages for conveying people and goods.

The last of the essentially descriptive studies with which we are concerned is Donald Bogue's *Structure of the Metropolitan Community*,[5] a doctoral dissertation which is perhaps the most stimulating of the many demographic contributions by this prolific sociologist. In it he seeks to prove the hypothesis that "great cities, or metropolises,

[4] John E. Brush, *The Population of New Jersey* (2nd edition; New Brunswick: Rutgers University Press, 1958). xi and 123 pp. $3.75.

[5] Donald J. Bogue, *The Structure of the Metropolitan Community; a Study of Dominance and Subdominance* (Ann Arbor: University of Michigan Press, 1950). x and 210 pp. $2.00.

dominate the social and economic organization of technologically advanced societies" according to a definite areal pattern, as well as in other ways. This is accomplished by arraying a great variety of 1940 census data for such topics as population characteristics, retail sales, services, wholesale trade, and manufacturing by the 67 metropolitan communities into which he has subdivided the territory of the United States. (Unfortunately, no map of these communities is provided.) Each community is assumed to be dominated by one or a cluster of cities meeting certain locational requirements and has boundaries determined by equidistance between its central city and those in neighboring metropolitan communities. Within the metropolitan communities, which are classified into four groups on the basis of the population of the central city, data for counties and cities of 2,500 and over are arranged areally and cross-classified in two ways: (1) by a series of nine distance zones based on the central city (running from 0–14 miles to 465 miles and over) and (2) within twelve 30° sectors radiating out from the central city and positioned so as to correspond as closely as possible with the chief intermetropolitan highways and railroads. These sectors are designated as either "intermetropolitan" (i.e., those roughly bisected by such highways or railroads), "subdominant" (when they were not intermetropolitan but contained a city of 25,000 or more), or "local" when they contained no major intermetropolitan movement or major hinterland city.

Adhering to this ingenious scheme, Bogue tabulated a great mass of data and analyzed them with meticulous care. His complex and interesting findings cannot be summarized here except to note that they do verify his hypothesis rather well, and we are supplied with a fairly coherent idea of the ways in which the central metropolis exerts its influence over various aspects of our society and economy in different sorts of communities at varying distances and angles from the metropolis. A critical geographer would, however, have to take exception to at least two aspects of Bogue's argument. His treatment of the effects of physical geography and the regional factor in Chapter IX is superficial, and much more rigorous investigation is called for before we can fully agree that the differences in land settlement among geographic regions are less than those associated with metropolitan organization. Secondly, I am far less convinced than is Bogue that the density of rural-farm settlement is a function of metropolitan dominance, at least beyond the innermost zones. Although it is true that farm population starts to thin out at distances of 100 miles or more from the central city, such a trend may be accounted for much more readily by factors in the physical environment (which also discourage the growth of large cities) than by reference to the remoteness of large cities. Incidentally, in all the works under review, except possibly Brush's, the distribution of rural–farm population, which is now, of course, a small and rapidly dwindling fraction of the national total, is relegated to a subordinate position in the discussion, and no serious attack is made on the question, certainly a promising one for the geographer.

There are, in addition, certain shortcomings in Bogue's basic research design which, even though acknowledged by the author, weaken the validity of his findings. The method of placing the boundaries for the metropolitan communities is convenient but hardly realistic. Could anyone contend that the line separating their zones of metropolitan dominance is equidistant between, say, Duluth and Milwaukee, Albany and New York, or El Paso and Los Angeles? But we can hardly blame Bogue for this method when geographers and other social scientists have not yet arrived at an adequate statistical formula for delineating urban hinterlands. Another more basic point is that the varying importance of the 67 metropolitan communities is not adequately handled merely by sorting them into four size categories. In actuality, many of these communities are probably portions of certain superregions of metropolitan dominance, e.g., those of New York, Chicago, Los Angeles, or Atlanta, and are stages in a continuum ranging upward from the isolated farmstead to Megalopolis. Bogue, it appears, was not sufficiently aware of previous work in the fields of location theory, "social physics," and the size–rank hypothesis, or various studies of the hierarchies of size, function, and zones of influence of settlements that have been carried on by certain geographers and economists. His monograph is, nevertheless, an important step toward the production of that

general theory of settlement size, location, and influence which we seem to be approaching through the cumulative efforts of such scholars as Brush, Christaller, Garrison, Green, Isard, Philbrick, Ullman, Vance, and others. Bogue's model, although relatively primitive, is worked through with great thoroughness and is most useful and suggestive; but his subsequent monographs, which detail the highly devious strands of population change, should also caution us that the more elegant models that are sure to come will have a validity limited to certain areas and periods and that they can approach but never wholly capture a complex, shifting reality.

Bogue's study of metropolitan dominance was, by definition, a static one, and it is regrettable that his plans to add another dimension by analyzing data for the periods before and since 1940 have apparently fallen by the wayside. We have, however, in Hawley's *The Changing Shape of Metropolitan America* a volume that does approximate a sequel.[6] This treatise deals with changes in the distribution of population and manufacturing industries within 157 Standard Metropolitan Areas during the period 1920–50. For the purposes of this analysis, eight distance zones are designated around the central city, so as to recognize trends in satellite cities and rural population; and these metropolises are classified by size, growth trends, distance from nearest metropolis, regional location, and type of location (relative to sea coast or major streams). This is a potentially exciting subject, and there are certainly many worthwhile data in the numerous tables and charts. It is hard for me to judge whether my reaction is purely personal or would be corroborated by other readers, but I found the writing intolerably dull and my progress through the book about as exhilarating as wading through a tank of cold molasses. The meaning of the text, which is principally a paraphrase of the tables, is often too dense to penetrate; and I should suggest reference to the tables, rather than the text, to anyone interested in the larger aspects of the subject or its details.

Eight of the items reviewed here are from the "Studies in Population Distribution," a major project carried out by Bogue and his associates at the University of Chicago and Miami University that might be compared to the Study of Population Redistribution at the University of Pennsylvania in the 1930's. It must be noted that several other monographs in this series of peripheral interest to population geographers have been omitted here and that there are many shorter pertinent articles by its participants appearing in various periodicals. Apparently the project is now complete except for the summary volume which, it is announced, will be a general treatise on population redistribution within the United States.

Bogue's *Population Growth in Standard Metropolitan Areas, 1900–1950*,[7] while strictly speaking not an item in the Studies in Population Distribution, is decidedly corollary or prefatory to the series. It consists of a lucid exposition of the methodology of the Census' Standard Metropolitan Areas and Urbanized Areas and the various uses and limitations of these areal units. Temporal and areal trends within and among the SMA's for a fifty-year period are offered through tables and text; and an analysis is made of the significance of these changes. The attempt to correlate them with other statistical data and thus achieve some explanation of differential growth is interesting but largely futile.

The central theme in this Chicago–Miami series of studies is the description and explanation of population change in the United States during the 1930's and 1940's. To that end, the authors have amassed great quantities of published and unpublished census data and scrutinized them in many ways. It must be noted here, at the risk of redundancy, that we do not yet have any sort of adequate geographic analysis of the distribution of American population for any point in our history, so that the initial distribution, usually either 1935 or 1940, from which change is plotted, is in itself an essentially unexplored phenomenon. We can hope that Bogue's summary volume, which may help tie up many other loose ends in this series, may also remedy this lack to some degree.

Since the authors realize that changes in

[6] Amos H. Hawley, *The Changing Shape of Metropolitan America: Deconcentration since 1920* (Glencoe, Ill.: The Free Press, 1956). 177 pp. $4.00.

[7] Donald J. Bogue, *Population Growth in Standard Metropolitan Areas, 1900–1950, with an Explanatory Analysis of Urbanized Areas* (Washington: Housing and Home Finance Agency, 1953). ix and 76 pp. $2.00.

vital rates are relatively sluggish and that most population redistribution in this country is effected through migration, their attention is largely focused on this topic. Here I must point out that the timing of this research project was not fortuitous, since it has only been since about 1950 that we have had enough data for the entire nation on both vital events and internal migration for such studies. The problem of measuring internal migration is approached via four distinct methods. The first, and simplest, is the use of the data on the place of residence in 1935 of those persons enumerated in 1940. Previous to the publication of the Bogue, Shryock, and Hoermann monograph,[8] the Census had issued only summary statements of this information, and Bogue has performed a considerable scientific service by rescuing from oblivion this unique set of data whose official publication, after being delayed by the war, was made impossible by the demands of the 1950 census. Table I in this study presents subregion of residence in 1940 by subregion of residence in 1935 for each of the 328 population subregions designated by O. E. Baker, or, in other words, data on no less than 107,584 streams of migration; and the only such table we have as yet for areas smaller than states, Table II, offers data on the characteristics of the in-migrants into each of the subregions. Although Bogue has furnished several maps depicting some outstanding facts revealed by this mass of data, it seems unlikely, as he maintains, that little will be gained by further cartographic analysis. In fact, it might be possible to gauge the potential of a graduate student for research in population geography by setting these tables before him and measuring his salivation rate.

The tables are accompanied by a valuable methodological discussion of internal migration and its measurement and by an analysis of some major trends in population movement and migration differentials revealed by the statistical data. In spite of the limitations of the data—namely, that they indicate only net migration of those surviving to 1940, show a large percentage of incorrect responses, and cover a study period quite atypical in the population history of the nation—the findings and their theoretical implications are most valuable. A multiple regression analysis of possible factors accounting for the size and composition of the streams of migration seems less successful to this reviewer than to the authors, who found that the value of R, or degree of association among variables, ranged from .70 to .96 for net migration. The analysis seemed rather to indicate that many characteristics of the population at destinations were highly correlated with those of in-migrants who, of course, usually form an appreciable portion of the former, but there is little real indication why migration between two different sets of places assumed a certain size or configuration.

The data published in the above-mentioned study and a large volume of unpublished tabulations on intrastate migration during the 1935–40 period stored at the Scripps Foundation for Population Studies were subjected to exhaustive study in two additional monographs. Bogue and Hagood in their study of the Corn and Cotton Belts[9] and Warren Thompson in his on Ohio[10] examine all possible social and economic differentials among the ranks of the migrants as opposed to nonmigrants and cross-classify their data by all possible combinations of source and destination. Although the analyses are laborious and demand the reader's closest attention, the findings justify the effort, for what emerges from both studies is probably the best statement yet available anywhere on the theory of differential migration. The various hypotheses put forward are too complex and highly qualified for any simple summary here, but it can be said that while they confirm several previously held beliefs, they nullify others,

[8] Donald J. Bogue, Henry S. Shryock, Jr., and Siegfried A. Hoermann, *Subregional Migration in the United States, 1935–40. Volume I. Streams of Migration Between Subregions; a Pilot Study of Migration Between Environments* ("Scripps Foundation Studies in Population Distribution," No. 5 [Oxford, Ohio: Miami University, 1957]). vi and 333 pp. $5.25.

[9] Donald J. Bogue and Margaret Jarman Hagood, *Subregional Migration in the United States, 1935–40. Volume II. Differential Migration in the Corn and Cotton Belts; a Pilot Study of the Selectivity of Intrastate Migration to Cities from Nonmetropolitan Areas* ("Scripps Foundation Studies in Population Distribution," No. 6 [Oxford, Ohio: Miami University, 1953]). vi and 248 pp. $2.25.

[10] Warren S. Thompson, *Migration within Ohio, 1935–40; a Study in the Redistribution of Population* ("Scripps Foundation Studies in Population Distribution," No. 3 [Oxford, Ohio: Miami University, 1951]). ix and 227 pp. $2.00.

and suggest several new promising avenues of research.

Additional material for a new theory of internal migration is available in a study in which Bogue analyzed labor mobility in Michigan and Ohio during 1947 through the use of OASI (Social Security) data for the workers in covered employment.[11] This is apparently the first such use of these data, but Bogue's results would suggest that further experiments with such material would be rewarding for both demographers and geographers. The conclusions reached by studying labor migration also supplant, in part, pre-existing theory and would indicate that the motivations behind migration — and nonmigration — are more complicated than hitherto suspected and that these factors can vary greatly from one place or time to another.

The last two methods used by Bogue for estimating internal migration are "residual" in character. In a monograph published in 1957,[12] the net internal migration for each State Economic Area and central city of each SMA for the 1940–50 interval is computed by subtracting the sum of reproductive change, i.e., total births less total deaths, from the intercensal change in total population for the area in question. Estimates of net migration, by age, color, and sex for the central cities and metropolitan ring of each SMA are provided by means of census survival ratios, a process in which the number of persons in a given age group expected to survive from the beginning to the end of the intercensal period is compared with the number actually counted in the second census and the difference attributed to migration. Even with the several adjustments and refinements to which the raw data are submitted, the results of these computations are only approximations, but of all the tabulations published in the series by Bogue and his associates, this monumental set is perhaps the most impressive. They furnish us for the first time with figures on the contributions of births, deaths, and migration to population change within small segments of the nation and the possible basis for advanced work on the interactions of social, economic, and demographic phenomena. Their value will be greatly enhanced, of course, if comparable data can be worked out for the 1950–60 and subsequent periods. In the same volume Bogue contributes a brief discussion of regional differentials in migration and reproductive change, interregional and intra-SMA shifts in age and color groups through these same media, and a none-too-successful attempt at finding explanatory factors for net migration in nonmetropolitan SEA's by linear correlation.

A word must be inserted about Bogue's system of areal units, for they are used extensively in this study. We cannot afford to be surly over his State Economic Areas since no better set of areal units intermediate between state and county is as yet generally available. But it is possible to quarrel with his larger Economic Subregions and, particularly, with the thirteen Economic Regions into which he has divided the nation. It is not clear from Bogue's account just how these major combinations of counties with their alleged homogeneity were worked out, whether by some exacting statistical procedure or by the subjective evaluation of all the many criteria involved. Some of the Economic Regions may meet with general approbation (I like especially his Rocky Mountain and Intermountain Region); but surely one may question a region which shelters both Cumberland, Maryland, and Traverse City, Michigan, or another containing both Columbus, Ohio, and Mitchell, South Dakota. Although this system of regions may be admirable for Bogue's special purposes, I think the mature geographer is well advised to cultivate the do-it-yourself technique in the region-building game. Another more general question is suggested by Bogue's hierarchy of socio-economic regions. Why was the "nodal" system adopted for his earlier "Structure of the Metropolitan Community" scrapped in favor of a system of "uniform" nonmetropolitan regions and truncated nodal metropolitan regions, especially since the former showed such definite promise?

[11] Donald J. Bogue, *A Methodological Study of Migration and Labor Mobility in Michigan and Ohio in 1947* ("Scripps Foundation Studies in Population Distribution," No. 4 [Oxford, Ohio: Miami University, 1952]). vi and 100 pp. $1.00.

[12] Donald J. Bogue, *Components of Population Change, 1940–50: Estimates of Net Migration and Natural Increase for Each Standard Metropolitan Area and State Economic Area* ("Scripps Foundation for Research in Population Problems and University of Chicago Population Research and Training Center, Studies in Population Distribution," No. 12 [Oxford, Ohio: Miami University, 1957]). v and 145 pp. $3.75.

For those who are particularly interested in the study of farm population, the Bowles study will be a major document.[13] Following the census survival ratio technique, Gladys Bowles has worked out tables of net migration by sex and color for each SEA for the 1940–50 period and by sex, color, and age for each of Bogue's Economic Subregions. An interesting, but minimal discussion of the results accompanies the tabulations. The potential user should note that the term "migration" is used here in a rather special sense, since it apparently includes not only ordinary migrants but also persons who enter or leave the rural–farm category through change of residence or occupation without necessarily crossing SEA or Subregion boundaries.

The Kitagawa–Bogue study of shifts in the distribution of manufacturing activity during the 1929–47 period within SMA's would be out of place here, as elegant a piece of work as it is, were it not for the fact that it includes a fairly extended analysis of the correlation of the movement of industry with changes in the residential location of factory workers.[14] The data do indicate something of a positive correlation but one subject to a good many qualifications; and it is not clear from the available statistics how much of a role in the suburbanization of the general population is played by outward shifts of industry. For anyone interested in manufacturing, either as a putative factor in population change or simply as a branch of economic geography, this study can be recommended as a shining example of the intelligent handling of some confusing data. A radical departure from the usual sociological study is the recognition that the important factors in determining shifts in manufacturing location vary greatly from one metropolis to another and the inclusion of a lengthy section in which the reports of local analysts—mostly planning officials—are quoted.

One aspect of metropolitan growth that should be of particular interest to geographers —the conversion of land to nonagricultural uses—is taken up by Bogue in a brief study that treats the small volume of available data —much of it defective—in as definitive a fashion as possible.[15] Although there is no mistaking the ultimate trend toward a reduction in the area of cultivated land as other land uses continue to expand, the short-term trends are less certain and, in some cases at least, reversible. In the highly urbanized and industrialized Northeast and in California a downward tendency in agricultural land within the SMA's seems firmly established. Elsewhere, the shifting demands of the agricultural market create a certain elasticity in the supply of farm land, while, among other complications, there is a quite imperfect correlation between population growth and residential construction. This slim monograph is of more than casual interest in that it is the only one on our list that reflects, however tangentially, any concern with the ultimate adequacy of our agricultural resources to support a steadily increasing population. The absence of even the merest whisper of Malthusian doctrine in the other scholarly works discussed here is possibly some clue to the vast disproportion between the wealth of the United States and most of the rest of the world.

The last of the Chicago–Miami publications to be considered is unlike the others in being a collection of papers presented at a symposium (Population Association of America, May, 1957) rather than a single research memorandum.[16] The group of papers constituting Part II, which deal with the population situation in the United States as of 1975, are of general interest in their cautious approach to the task of prognostication. After the chas-

[13] Gladys K. Bowles, *Farm Population; Net Migration from the Rural–Farm Population, 1940–50* ("Agricultural Marketing Service, Statistical Bulletin," No. 176 [Washington: U. S. Department of Agriculture, 1956]). 174 pp. $1.00.

[14] Evelyn M. Kitagawa and Donald J. Bogue, *Suburbanization of Manufacturing Activity within Standard Metropolitan Areas* ("Scripps Foundation for Research in Population Problems and University of Chicago Population Research and Training Center, Studies in Population Distribution," No. 9 [Oxford, Ohio: Miami University, 1955]). vi and 162 pp. $1.80.

[15] Donald J. Bogue, *Metropolitan Growth and the Conversion of Land to Nonagricultural Uses* ("Scripps Foundation for Research in Population Problems and University of Chicago Population Research and Training Center, Studies in Population Distribution," No. 11 [Oxford, Ohio: Miami University, 1956]). 33 pp. $ .60.

[16] Donald J. Bogue (ed.), *Applications of Demography; the Population Situation in the U. S. in 1975* ("Scripps Foundation for Research in Population Problems and University of Chicago Population Research and Training Center, Studies in Population Distribution," No. 13 [Oxford, Ohio: Miami University, 1957]). vi and 96 pp. $2.10.

tening experience of the 1940's, demographers seem to have devoted less of their time to projections of future conditions and more to the study of past and present. These forecasts of population size, color composition, regional distribution, urbanization, labor force, farm population, school enrollment, and number of marriages are carefully reasoned and offer few surprises.

The final item on our list is potentially the most important, but, unfortunately, at the time of writing there was available only the first of two volumes reporting the results of the Study of Population Redistribution and Economic Growth in the United States, 1870–1950, carried on at the University of Pennsylvania since 1951 under the direction of Simon Kuznets and Dorothy S. Thomas.[17] This initial volume contains "(1) descriptions of procedures developed to convert masses of disparate and defective data from censuses and other administrative collections into sets of analysis-directed estimates; (2) evaluations of the validity and reliability of these estimates; (3) the estimates themselves." Volume II will present, among other items, "an over-all summary of the significant interrelations among the demographic and economic measures." From the glimpses afforded by brief résumés in periodical articles and mimeographed reports, the findings of Volume II promise to be a most substantial addition to our understanding of the vexing but vastly important subject of the interaction of economic and demographic forces. Meanwhile, it can be stated that Volume I will become an indispensable part of the reference collection of any student concerned with either the economic or demographic history of the United States. Although all the statistics originate in sources that have been public for some time, the authors have executed a monumental task in adjusting, converting, arranging, and otherwise rendering comparable figures for each state and for each census year from 1870 onward for total population by race, nativity, and urban–rural residence, labor force composition, various measures of manufacturing activity, and various forms of income. In addition, there are tables of net intercensal interstate migration by nativity, color, sex, and age worked out by the census survival ratio technique, the first time we have had such a body of data. Material for an alternate method of estimating interstate migration is provided in tables giving data on state of birth by selected states of residence, and vice versa, for native whites and nonwhites.

The seeker after perfection may complain about the absence of pre-1870 data or the failure to carry the study below the state level, but the lack of essential data made such improvements manifestly impossible. The text contains detailed accounts of the difficulties offered by the data, many of them hair-raising, and the methods used to circumvent them. Although the material on manufacturing, labor force, and income will be of great interest to the economic geographer, the population student's primary concern will be with Everett S. Lee's handling of the migration estimates. His methodological exposition is admirable and the tables themselves occasions for awe, enough to start any geographer's mapping arm twitching, since no maps are included in Volume I. Altogether a remarkable bargain for $5.00.

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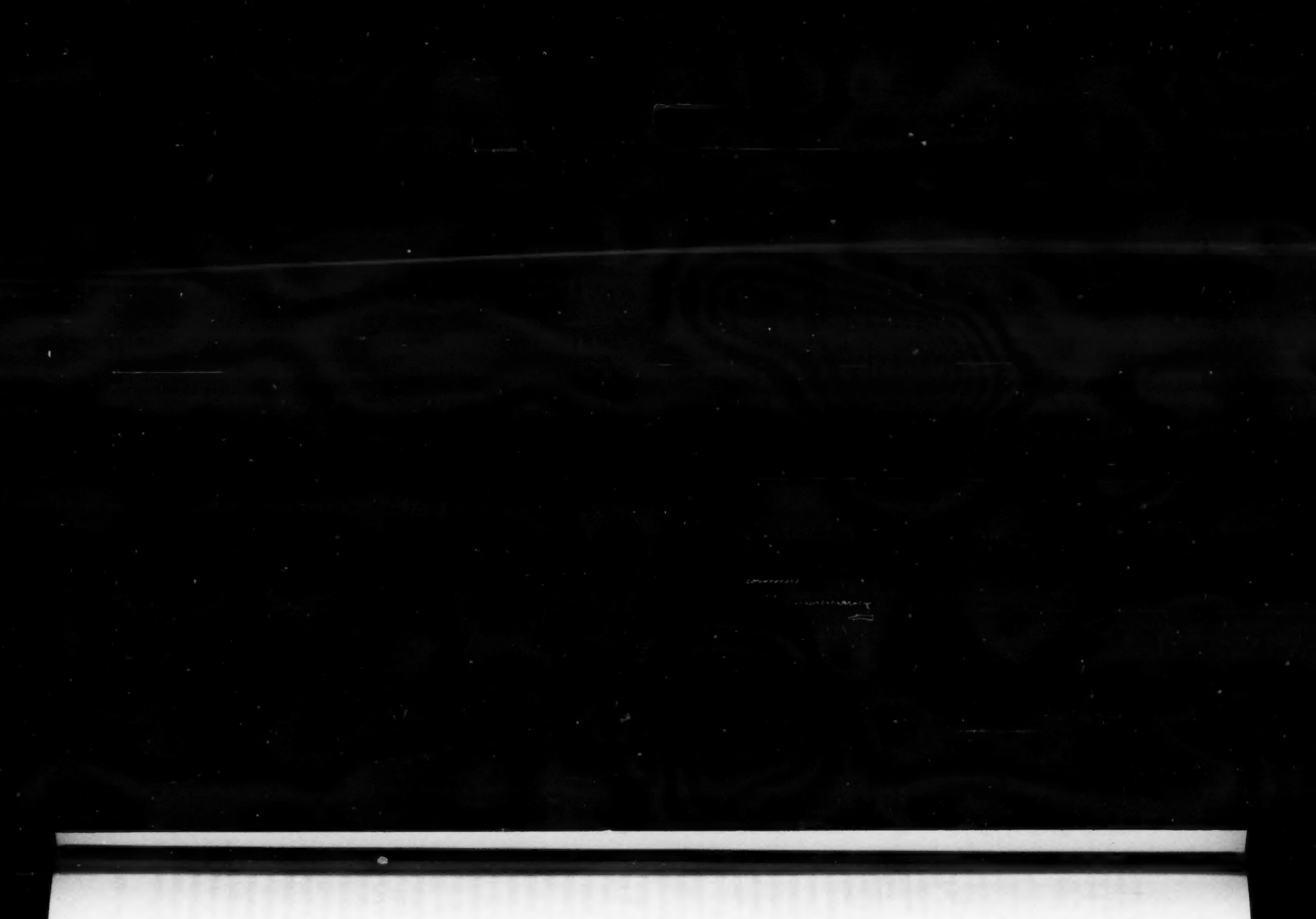
[17] Everett S. Lee, Ann Ratner Miller, Carol P. Brainerd, and Richard A. Easterlin (under the direction of Simon Kuznets and Dorothy Swaine Thomas), *Population Redistribution and Economic Growth, United States, 1870–1950. I. Methodological Considerations and Reference Tables* ("Memoirs of the American Philosophical Society," Vol. 45 [Philadelphia: American Philosophical Society, 1957]). xix and 759 pp. $5.00.